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MANAGEMENT HANDBOOK

To Aid Emergency Expansion of

Dehydration Facilities for Vegetables and Fruits

VOLUME II

CRANBERRY SUPPLEMENT

A Phase II Preparedness Study

Prepared at the Request of
Office of the Quartermaster General
Department of the Army
Washington, D. C.

By

Western Regional Research Laboratory
Bureau of Agricultural and Industrial Chemistry
Agricultural Research Administration
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BASIC ASSUMPTIONS

Foreword

The planning of a dehydration plant for meeting national emergency needs should take full cognizance of the information and suggestions given in Volume I of this Handbook. This set of plans for a cranberry dehydration plant is based upon the principles set forth in that portion of the Handbook.

Product Desired

This plant is designed to produce dehydrated cranberries (Type II — Sliced) in accordance with Military Specification "Cranberries, Dehydrated" (MIL-C-827A) dated 4 September 1951.

The specification provides for alternate methods of packaging:

1) One pound of product packed in a hermetically sealed metal can

2) One pound of product packaged into a carton which is then sealed and wax-dipped

For both methods, the product must be compressed. Because of the lack of successful commercial experience on Method (1), and because one company is successfully using Method (2), the latter method is illustrated in this Handbook Supplement.

The military specification provides for alternate methods of packing the wax-dipped cartons: (1) In a fiberboard box inclosed in a waterproof plastic and aluminum foil bag, or (2) in a 5-gallon, hermetically-sealed-type metal can. The latter method is used in the illustrative material in this Handbook Supplement mainly because of its relative simplicity and surety of operation.

For comparative purposes, the probable costs for packaging the product in #2½ tin cans are indicated, provided that suitable equipment can be made available for can filling and compressing.

Type I (powdered) cranberries, also covered by this same specification, can be produced in this plant with other additional equipment (described in Chapter III — "Plant Procedures and Facilities"). The product designated as Type III (whole) cranberries, also covered in this specification, is not known to have been produced commercially, and the present status of the technology does not seem to warrant its production in the near future.

Bases for Operation, Facilities, and Cost Estimates

A. Location of Plant

Most of the cranberry dehydration to date has been done in the States of Massachusetts and Washington. These estimates are therefore based on location of

plants in these areas. The general plan, design, and operations are applicable, however, to plants located in other areas.

B. Operating Basis

Design and cost estimates are based on an operation of three 8-hour shifts per day, six days per week, for a 100-day season during the period September through December. Labor rates used are those common in Massachusetts for unskilled labor, and are adjusted to the bracket classification used in the other dehydration plant plans. These adjusted rates will be different in some cases from the rates actually paid in the Massachusetts area, but this procedure puts the various plants on a comparable basis for cost estimate purposes. The labor rates used in this set of plans are as follows:

Class Labor	Hourly Rate
1	$1.50
2	1.30
3	1.20
4	1.10
5	1.00
6	0.90

C. Raw Commodity Used

The cranberries used for dehydration are assumed to be of such quality as specified in the Military Specification (MIL-C-827A) for raw material. They shall be from the current crop and shall not be frozen prior to dehydration. Fresh berries are available two months during the harvest season (September - October) and for two months from common storage (November - December). Provision has been made in the cost estimates for raw commodity prices ranging from $100 to $600 per ton. It has been assumed that all the cranberries received at the plant will have been graded for quality and size and are acceptable for dehydration.

D. Plant Capacity and Yields

This plant has been designed to process 50 tons of raw cranberries per day. It is assumed the preparation line will operate 20 hours a day and have a nominal capacity of 2-1/2 tons of raw cranberries per hour. The dehydration tunnels and bins will operate 24 hours per day to dry the material prepared in 20 hours. The packaging line will operate 20 hours per day.

The over-all shrinkage ratio for this plant is assumed to be 10 : 1 (which is considered normal for presently operating plants). On this basis, 100 pounds of raw cranberries entering the processing line will yield 10 pounds of packaged dried product.

E. Storage Space

Storage space in the plant building is provided in this set of plans for handling a raw material supply equivalent to five to seven days of plant operation. Storage space has been provided for a 30-day production of packaged and cased dehydrated cranberries plus a 7-day supply of empty cans and cases, or any combination of these items.

F. Waste Disposal

In a cranberry plant, the amount of waste material would be small, and these plans have assumed that no return will be realized from and no cost will be incurred in the disposition of the wastes.

CHAPTER II

SUPPLY OF RAW CRANBERRIES

Characteristics Desired in Raw Products to be Dehydrated

Cranberries for dehydration must be mature, well-developed, sound, clean, free from surface moisture, and be of characteristic red color. They must be free from brown, soft, or rotted berries. A large size berry with a thin skin is desirable. Military specifications provide that only berries from the current year's crop shall be used for dehydration, and that they shall not be frozen prior to dehydration. This requires that the dehydration must be carried on from early September (when the first of the early crop is available) to late December (when the last stored fresh berries are available).

Suitable Dehydration Varieties and Commercial Production Data

The two principal varieties of cranberries produced are Early Blacks and Howes. The McFarlin variety is also an important variety produced commercially. Another portion of cranberry production is from mixed vines of more than a single variety. In the leading cranberry-producing State (Massachusetts), the production is about 50% Early Blacks and 40% Howes. The Early Black is pear-shaped to oval in form. It ripens in early September and must be picked as soon as ripe to avoid rotting. It should be marketed before Thanksgiving. The Howes is oval in form. It ripens in October and the later it is picked, before a hard frost, the better it will keep. The Early Black does not keep well because it ripens and is harvested when the average daily temperature in Massachusetts is still relatively high, about 64° F. The Howes variety, on the other hand, has the advantage of being harvested at the end of November, when the average daily temperatures are closer to 40° F.; this results in better keeping conditions for the berries after harvest.

The McFarlin variety accounts for about 75% of the berries grown in the Washington and Oregon bogs. The McFarlin berries are large, and oval in shape. This variety is a good keeper when grown on the Pacific Coast, or in Wisconsin, but its qualities are uncertain and variable when it is grown in Massachusetts.

In New Jersey, the majority of the cranberries produced from mixed unselected vines are designated as "Jerseys". The Early Blacks and Howes make up about one-third of the acreage.

In Wisconsin the crop is mostly from mixed vines and sold under the designation "Natives". About 15% of the acreage is of the McFarlin variety.

Other fancy cranberries considered prime for the table, and hence for dehydration, are: Bugle, Centennial, Centerville, Holliston, and Mathews. Aviator is the most promising of the newer varieties. Round Howes is considered the most productive. The Searles variety (Searles Jumbo), in Wisconsin, is a large berry and very productive. McFarlins, Shaws Success, and Early Black are quite resistant to false blossom; nearly all others are not resistant to any extent.

PNEUMATIC CRANBERRY HARVESTER

(Courtesy of NATIONAL CRANBERRY ASSOCIATION)

New varieties are continuously tested for future planting by the Bureau of Plant Industry, Soils, and Agricultural Engineering, of the U. S. Department of Agriculture.

A small area of southeastern Massachusetts accounts for about two-thirds of the national production of cranberries. In Wisconsin, second in rank in production, the acreage is scattered in bogs throughout the State. Pacific Coast production accounts for less than 10% of the total. Production, yields, and price data for the principal cranberry producing States are shown in Table I.

Procurement Problems

A. Propagation of Vines

The cranberry plant is propagated by the planting of cuttings; the growing is done in bogs. The cuttings are thrust down through the sand into the moist peat soil. The cuttings are obtained from relatively new and vigorous plantings. The vines are mowed with a scythe or mowing machine and taken in barrels or bags to the area to be planted. Planting is usually done from early April to the middle of May.

A cranberry bog comes into bearing about four years after planting. For this reason the supply of cuttings does not enter into the immediate problems of expanding cranberry dehydration. Due to the long-term nature of getting a new cranberry bog into production, comparable with that of tree crops, it is not likely that a military demand for cranberries for dehydration would result in any important immediate expansion of cranberry production.

B. Soil, Fertilizer, and Other Cultural Requirements

The most desirable natural site for cranberry growing is a leatherleaf and sphagnum swamp or bog. Cranberries require an acid peat soil, and a supply of sand is necessary for spreading over the peat. The natural site should be nearly level and fairly free from brush and trees. In most situations drainage must be provided so as to hold the watertable at least 18 inches below the surface. Irrigation facilities must also be provided so that the bog may be flooded in winter and also flooded for frost protection (when a freeze is imminent). Flooding is also used to control insects and weeds. The bog should not be too large. Those of less than 20 acres and of long and narrow shape are usually more easily managed and more profitable.

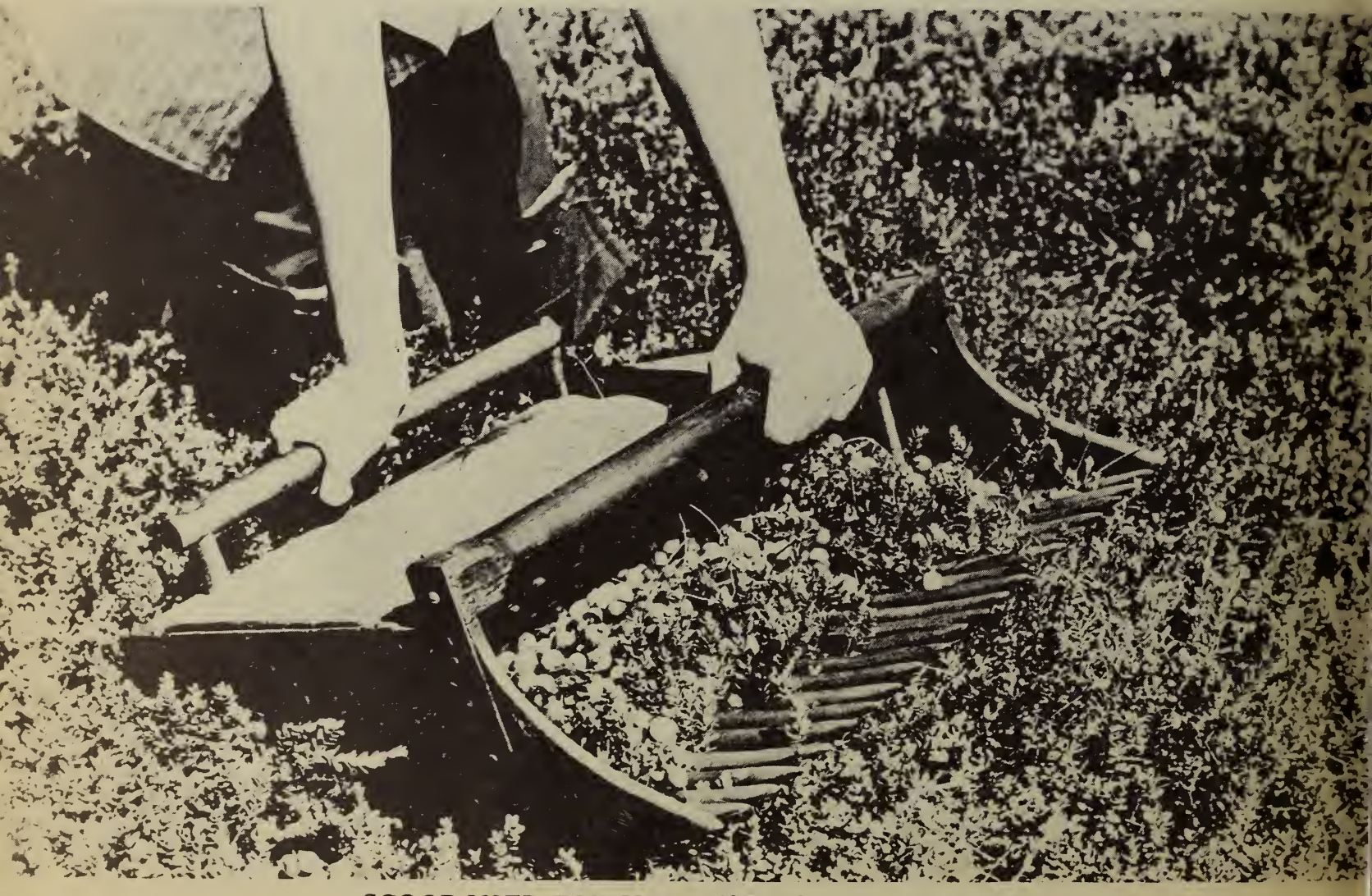
After being leveled, the bogs are sanded to fill depressions and other irregularities, to reduce the cost of weeding, to induce a more vigorous growth of the new cranberry vines, and to help control insects. In the establishment of a bog, sand is applied in a layer about three inches deep. Additional lighter sandings are made after the second and after the third or fourth year of growth. These applications of sand induce "runners" (of the vines) to become well rooted and the vines to grow with heavy stands of uprights which increase the yield of berries and make them easily picked with scoops. The sand is often applied on the ice after a winter flooding.

Typical seasonal operations in a cranberry field may be summarized briefly as follows:

January, February, and March — Care for winter flooding, adjust the water depth, and place sand on the ice if needed.

MANUALLY HARVESTING CRANBERRIES WITH SCOOPS

(Courtesy of NATIONAL CRANBERRY ASSOCIATION)



SCOOP USED FOR HARVESTING CRANBERRIES

(Courtesy of NATIONAL CRANBERRY ASSOCIATION)

April and May — Remove the water kept on bog during winter, reflood when frosts threaten, and begin weed control.

June — Re-flood to control insects and pests, continue weed control, and spray to control insects.

July — Continue weeding and spraying.

August — Prepare for the harvest by engaging harvest labor and improving roadways.

September — Harvest early varieties and flood when frosts threaten.

October — Harvest late varieties, rake off loose vines, and prune where necessary.

November and December — Put on winter flood, and begin resanding where needed.

C. Harvesting of Cranberries

The cranberry harvest usually starts about the first of September and continues on through October. Cranberry varieties differ in date of ripening and degree of maturity at which they should be picked. The approach of freezing weather limits the time available for harvesting the crop. Table II and Figure 1 give the usual cranberry harvesting periods according to State and variety.

Only one picking of cranberries per season is made. Much of the picking is done by mechanized suction pickers which harvest the berries at a cost of $2.50 to $3.00 per 100 pounds. A new mechanical harvester is now available on the Pacific Coast which is expected to harvest the crop for $1 to $2 per 100 pounds. In the Eastern States a special scoop or rake is used manually to gather the berries; by this method, however, 10% to 30% of the berries may be missed by the pickers. Any berries left by mechanical harvesting or by scoop picking are recovered by flooding the bog and then scooping up the floaters which rise to the surface. These floaters must be dried carefully and utilized at once as they are soft and will not keep.

Hand picking now costs two to three times as much as present mechanical picking but results in better quality berries and leaves fewer berries in the bog. Processors prefer handpicked berries to those mechanically harvested, particularly if they are to be stored, because of the better keeping quality.

D. Storing Raw Cranberries

Most cranberries are held from a few weeks to several months in storage houses, which are located at the bogs or in grading plants. The annual loss from cranberry spoilage is estimated to be at least 25 percent of the crop, with practically all of this loss occurring after harvesting.

A fungus peculiar to cranberries and related plants is the cause of most of the decay in storage. The fungus gains entrance to the fruit while it is on the vine. Experience has proved that crops from certain bogs have better keeping qualities than those from other locations. These differences may be due to certain cultural practices in connection with the flooding water, or, in some bogs, to the excessive use of fertilizers containing nitrogen.

The higher the temperatures to which cranberries are subjected, the greater is the loss from decay. The fruit should, therefore, be kept cool all through the harvest, sorting, storing, and shipping periods. For very long storage, it is customary to hold cranberries in field crates without cleaning or sorting the berries. The most favorable storage temperature range for fresh berries is 36° to 40° F. Cleaned and sorted cranberries can be held for six to eight weeks at an even lower temperature, but thereafter low temperatures of about 32° F. cause a breakdown of the cells and the development of rubberiness in the berries. At 27.7° F. the cranberries will begin to freeze. Poorly colored cranberries are sometimes stored at higher temperatures (45° to 50° F.) in order to hasten the coloring, but such berries which have been stored at higher temperatures do not keep well.

There should be ample ventilation to keep the temperature around the berries uniformly low and to avoid condensation of moisture on the berries. Fresh cranberries should be stored under conditions of 85% to 90% relative humidity in order to minimize loss of moisture and weight. Sufficient spoilage usually develops in two months, even under the most favorable conditions, to require recleaning of the fruit before it is packed for market.

It is improbable that the fresh-fruit shipping season can be extended much beyond its present limits by the use of cold storage. These limits are about two months after the completion of harvesting. After that date the remaining unmarketed berries are frozen and so held for later production of juice, sauce, or jelly, or canned as whole berries. The Military Specifications for Type II (sliced) product require the use of berries that have not been frozen. This effectively limits the dehydration season to about December 31st.

E. Competing Outlets for Cranberries

Cranberries are marketed for the most part by either the American Cranberry Exchange or the National Cranberry Association; both organizations are grower-owned and grower-operated cooperatives. The former deals mainly in berries for the fresh market and the latter in berries for processing. Outlets for cranberries other than through these two associations are of no practical importance.

Because of the long period required to bring new cranberry bogs into production, any supplies of raw commodity needed immediately for emergency dehydration would have to be diverted from present outlets. If the emergency were of long enough duration and the demand great enough, new bogs could be brought into production in about four years.

F. Competition with Other Crops for Acreage

The special natural conditions of a leatherleaf or sphagnum swamp or bog required for a cranberry bog usually excludes any possibility of having to compete with other crops for the use of land. It is swamp land, otherwise idle, that has been developed into cranberry bogs.

An investment of $4,000 to $5,000 per acre is necessary to bring a bog into production, but once established the bogs are practically permanent. There are good bearing bogs in Massachusetts that are 80 years old and have yet to experience an appreciable diminution in yield due to age. Because of the high cost and long life of these bogs, the acreage of cranberries does not change greatly. The total acreage devoted to this crop in Massachusetts has been between 14,000 and 15,000 acres for the past 40 years.

In Wisconsin, cranberries are reported now being grown on elevated land under irrigation with yields up to 180 barrels per acre. This development is still strictly experimental.

G. Considerations in Obtaining Cranberries of Proper Grade

Cranberry growers in the United States have found it to their advantage to band together in cooperative associations to process and to market their commodity. Nearly all of the commercial growers and processors are affiliated with such associations. It is customary for growers to receive cultural, harvesting, and marketing advice, as well as financial aid through their cooperative association.

The cranberries dehydrated during World War II were produced mainly under such cooperative arrangements. Processing equipment and the technical skill is still in the hands of such cooperatives.

If new plants are required in order to dehydrate cranberries in quantities greater than is possible with existing cooperative facilities, then the operators of such new processing plants should assure themselves of firm commitments for a satisfactory quantity of suitable raw material. The quality of the berries going into dehydration must conform to the requirements of the military specifications. The best commercial growing practices will be required to secure this quality.

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Stevens, C. D., and others. The Cranberry Industry in Massachusetts. Amherst, Mass., 1936. (Mass. Agric. Experiment Station Bulletin 332) 36 p.

TABLE I

Cranberry Production, Yields, and Prices for the Principal Producing States

State	Ten-Year Average -- 1940 through 1949				1949 Price	1950 Price	Leading Varieties Grown
	Production 1/ (Tons)	Acreage (Acres)	Yield (Tons per Acre)	Price (Dollars per Ton)	(Dollars per Ton)		
Massachusetts	23,430	14,490	1.62	332	186	175	Early Blacks; Howes
New Jersey	3,770	7,770	.49	328	188	165	"Jerseys"
Wisconsin	6,850	2,720	2.50	352	202	190	"Natives"
Washington	1,755	680	2.60	303	128	175	McFarlin
Oregon	605	199	3.18	324	154	174	McFarlin
Total (5 States)	36,410	25,859	-	-	-	-	-
Average	-	-	1.40	334	187	177	

1/ Production used for dehydration: 6,421 tons in 1943; 3,065 tons in 1944; and 2,240 tons in 1945.

Prepared from data reported in:

U. S. Bur. of Agric. Economics. Crop Production, Annual Summary, 1951. Washington, D. C., 1951 (Dec.)

U. S. Bur. of Agric. Economics. Fruits (Non-citrus) Production ... 1889-1944, 1945-47, 1948-49, 1949-50. Washington, D. C., 1948-51

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TABLE II

Usual Cranberry Harvesting Periods by State and Variety

State	Variety	Harvest		Growing District
		Begins	Ends	
Massachusetts	Early Black Howes	Sept. 1 Oct. 1	Sept. 25 Nov. 1	Cape Cod
New Jersey	"Jerseys"	Sept. 1	Oct. 5	Pine Barren
Wisconsin	"Natives"	Sept. 1	Oct. 1	Central and northern
Oregon	McFarlin	Sept. 15	Nov. 1	Coos Bay
Washington	McFarlin	Sept. 15	Nov. 1	Grayland

Source:

Franklin, H. J., Darrow, G. M., and Malde, O. G. Cranberry Harvesting and Handling. 1924 (U. S. Dept. of Agriculture Farmers' Bulletin 1402)

Bain, H. F., Bergman, H. F., and Wilcox, R. B. Harvesting and Handling Cultivated Cranberries. 1942. (U. S. Dept. of Agriculture Farmers' Bulletin 1882)

Interview by Ross Crane with W. J. Jacobsen, Branch Manager, National Cranberry Association, Markham, Wash.

DUSTING A CRANBERRY BOG TO CONTROL FUNGUS AND WORMS

(Courtesy of NATIONAL CRANBERRY ASSOCIATION)

CHAPTER III

PLANT PROCEDURES AND FACILITIES

This section gives pertinent information concerning the operating procedures and the facilities required for a plant producing Type II (sliced) dehydrated cranberries. The information is coded and presented in accordance with the classification key given in Appendix D ("Operation Classification Code") in Volume I. The accompanying flow-sheet, drawings of equipment and facilities, and other illustrative material have been labeled in accordance with this same classification. (Note: This same classification key has been used in compiling the "Cost of Facilities" and "Total Production Costs", and thus affords a useful cross-reference system for identifying or discussing any phase of the operations and/or costs.)

The operational procedures and facilities needed for this proposed cranberry dehydration plant are presented in accordance with the attached flow-sheet (Figure 2). A floor-plan (Figure 3) is given to show the space and arrangement required for the facilities.

100 — RAW MATERIALS

The problems and methods of procuring a suitable supply of cranberries for a dehydration plant have been discussed in "Supply of Raw Cranberries" in Chapter II.

It is assumed that grading for quality and size will be done by the supplier. It is further assumed that crates will be supplied by the cranberry associations, excepting for the seven-day supply of crates provided in the equipment list (Code 170 — Table I, Chapter IV). If crates are not available from the supplier of raw commodity, however, the dehydrator must supply a sufficient number to hold the cranberries during the two or three month storage period anticipated.

200 — MANUFACTURING OPERATIONS

210 — Raw Material Handling

211 — Weighing

It is assumed that cranberries received at the plant will be in 50-pound net-weight bushel crates (weight guaranteed by seller).

212 — Unloading and storing at the plant

Space has been provided for storage of a 5- to 7-day supply of raw cranberries at the plant to assure smooth operation. Pallets have been provided for holding a 7-day supply of cranberries on pallets at the plant. Crates have been provided for handling the cranberries from the sellers' plant and for storage in the plant for seven operating days.

213 — Feeding to line

The loaded crates are manually removed from the pallets and dumped in the receiving hopper, and the empty crates stacked on another pallet for removal.

220-230 — Preparing

A diagrammatic sketch of the "preparation line" for the proposed cranberry plant is given in Figure 4.

221 — Washing
224 — Inspecting

The cranberries are washed by immersion in water, with mild agitation to prevent bruising.

The berries are then drained on a wire mesh belt and inspected for off-colored or unsound berries, and for pieces of metal and other debris.

226 — Cutting (slicing)

Cranberries are sliced to increase the drying rate. Slicing is accomplished by means of a standard kraut-cutter or machine of similar design. A kraut-cutter with five 6-inch knives mounted on an 18" diameter disc head will slice a barrel (100 pounds) of cranberries per minute.

240 — Drying

The various types of dehydrators which may be applicable in the drying of cranberries are discussed in Volume I, Chapter X, of this Handbook. A truck-and-tray tunnel drier is proposed in this Supplement.

241 — Tunnel drying

241.1 — Tray loading

The empty drying-trays are carried on a variable speed chain conveyor under a vibrating spreader which is mounted below the slicing machine. The sliced cranberries fall onto the chute of the vibrating spreader which spreads the cut commodity evenly on the trays. The depth of loading on the trays may be controlled by varying the speed of the chain conveyor as desired. Provision may be made to shut off automatically the spreader at the end of each tray and re-start it for the next tray. When properly controlled this equipment should give uniform tray loading with a minimum of spillage.

Tray loading has been assumed to be approximately 1.0 pound per square foot, to conform with present practice in the cranberry dehydration industry.

241.2 — Tray stacking

The loaded trays are conveyed to a mechanical stacker and stacked on the trucks for drying. (Trays are stacked both manually and mechanically in the industry.)

241.3 -- Weighing

Before entering the drying tunnel, each loaded truck is weighed on scales built underneath a section of the track.

241.4 -- Tunnel operating

Cranberries are dried commercially in truck-and-tray tunnel driers employing either cross-flow or counter-current-flow air. A single-stage, overhead direct-fired twin tunnel, as illustrated in Figures 5 and 6 , has been selected for this emergency cranberry plant.

The following data have been selected as good design and operating characteristics for a cranberry tunnel drying system of the proposed capacity:

1.	Direction of air flow	Counter-current
2.	Air velocity between trays	500 ft./min.
3.	Volume of air per single tunnel	12,500 c.f.m.
4.	Type of firing	Direct (overhead)
5.	Type of fuel	#1 stove oil
6.	Hot-end air temperature	170° F.
7.	Tray loading	1.0 lb./ sq. ft.
8.	Size of trays	3 ft. x 6 ft.
9.	Number of trays/truck	25
10.	Trucks in tunnel during operation	12
11.	Moisture content of product entering	87%
12.	Moisture content of product leaving	11%
13.	Drying time	6 to 8 hours

To meet the production requirements under the foregoing operating conditions, three twin tunnels (six single units) are recommended for a 50-ton per day cranberry plant.

The heating capacity of the combustion chambers is based on a minimum outside air temperature of 10° F. In localities where lower temperatures are anticipated, the combustion chamber must be designed for greater capacity.

241.5 -- Tray unloading and stacking

Semi-automatic tray unloading has been provided in the proposed plant. After the trays are unloaded, either of two methods may be chosen to convey the trays to the loading station: (1) The trays may be re-stacked on a truck and wheeled to the

loading station, or (2) the trays can be conveyed to the loading station on the same conveyor used for moving the trays under the slicer. Under Method (2), the empty trucks are wheeled on the tracks under the tray conveyor, through the tray dumping station, and to the tray stacker for reloading.

The tray conveyor has been selected as a labor-saving item in small-plant operation. Tray loading and unloading must be carefully synchronized to assure smooth operation when using this procedure.

241.7 — Tray washing

In industry, the frequency of tray washing varies from three to four times a season to every time the trays are unloaded. For this plant it is proposed that the trays will be washed each week. Tray washing may be done by a special crew on Sundays or other days when the processing line is shut down; tray washing may be conveniently done on the tray conveyor between the tray unloading and the tray stacking stations. High pressure water and steam should be provided at the spot selected. Banks of spray nozzles both above and below the tray level on the conveyor, and a suitable housing to prevent splashing, can be provided for use when the trays are to be washed.

248 — Bin drying

Portable bins are provided for finishing-drying, moisture equalization, and storage.

The following data have been used as a basis for the designing and operating of the bin-drying facilities in the proposed plant:

1. Air flow rate through bins — 25 c.f.m./sq. ft. of bin cross-section
2. Inlet air temperature to bins — 150° F.
3. Drying time — 2 hours minimum to 10 hours maximum
4. Bulk density of dried cranberries (4% to 6% moisture content) — 10 to 12 lbs./ cu. ft.
5. Depth of material in bins — 4 ft.

Figure 7 illustrates a suitable bin, and Figure 8 shows a suitable bin room in which to complete the cranberry dehydration.

248.1 — Bin loading

The dried cranberries on the trays coming from the tunnels are emptied into a hopper and elevated to a conveyor which transports the dried cranberries into portable bins in the bin drying room. Each bin holds approximately 2-1/2 hours production.

After the bins are loaded, they are connected to the hot-air duct in the bin room to accomplish the final drying and moisture equalization of the product.

248.2 — Bin operating

It is anticipated that 10 bins will provide adequate capacity for plant production. Space is provided for five bins on the hot-air duct. An additional five bins are provided for loading, unloading, and holding of dried cranberries as required.

248.3 — Bin unloading

The contents of the drying bins are dumped by lifting the bins by means of an electric hoist.

250 — Screening and Inspecting

252 — Screening

Screening is not required as "fines" are not objectionable according to the military specifications.

A plate magnet is mounted under the discharge of the elevator to the inspection line to remove iron and steel fragments that may be in the dried product.

255 — Inspecting

The dried cranberry slices are inspected for scorched or discolored pieces and for contaminating material (such as wood splinters, hair, etc.). The inspection is done while the product is carried along on a continuous conveyor belt going to the packaging operation.

260 — Packaging and Packing

261 — Filling, packing and sealing

Dehydrated cranberry slices, according to Military Specifications, may be compressed into cartons (approximate size 4-1/4 x 2-3/4 x 4-1/2 inches) or compressed into cans (401 x 411), either container holding one pound of product.

Cranberry processors have built automatic and semi-automatic equipment to press cranberry blocks for packaging in cartons and in cans. However, the only automatic equipment known to be satisfactory, at the present time, is for compressing dehydrated sliced cranberries into blocks which fit into cartons. This equipment is owned by the A. D. Makepeace Co. Wareham, Mass. Two such machines were built for them by the Pneumatic Scale Corporation, Ltd., Quincy, Mass. These machines weigh heated cranberry slices, fill the press mold, and compress the block automatically. The blocks are manually inserted into the cartons and the cartons are sealed. Semi-automatic carton sealing is provided. It is believed that this machine can be adapted by the use of a cylindrical mold and plunger to compress blocks for a No. 2-1/2 can (401 x 411).

For this emergency cranberry dehydration plant, these types of machines are acceptable models for automatic pressing equipment. Some processors use manually operated presses for compressing cranberries into blocks.

Prior to compressing, the cranberries are heated by a bank of infra-red lamps mounted over the conveyor carrying the product to the pressing station. The compression ratio used for making cranberry blocks is about 3 to 1.

In cranberry plants, spillage of otherwise acceptable product may become a costly variable. Excessive spillage may occur around the compression machines particularly when they are out of adjustment. Losses may also occur around the slicer and at the discharge end of the tunnels.

Two alternate packaging operations are provided.

a) Packaging in one-pound cartons

The blocks from the press are inserted into the formed carton and the flaps are glued manually and placed in the compression belt sealer. From the sealer the cartons are automatically wax-dipped and cooled; 17 cartons are manually packed into a 5-gallon can and sealed. Cartons are purchased printed as specified.

b) Packaging in No. 2-1/2 Cans (401 x 411)

It is assumed that the cranberry slices will be pressed into the cans or that pressed cylindrical blocks will be formed and inserted into the cans. The cans will be sealed and conveyed to the casing station. Cans should be purchased lithographed according to specifications.

262 — Case-forming, filling, sealing, marking

Specifications for wax-dipped cartons packed in 5-gallon cans require packing in nailed and strapped wooden cases, two cans to a case. For No. 2-1/2 cans, fiberboard cartons of definite types are specified; each carton holds 24 cans. Military bids and contracts will specify the exact types of packing to be supplied by the dehydrator. Present-day dehydrators use either mechanical or manual casing operations. In this plant manual casing operations are recommended.

270 — Warehousing and Shipping

In keeping with the current trend, the proposed plant utilizes pallets for handling and storing of the finished product in the warehouse.

GENERAL FACILITIES

The requirements for other needed facilities have been discussed in Volume I, and the information will not be repeated here. The principal "general" facilities for the cranberry plant are listed in the "Cost of Facilities" for this proposed plant and include equipment for utilities maintenance and repairs, inspection and control, miscellaneous plant facilities, automotive, and administrative facilities and supplies.

325 — Waste disposal

"Preparation" wastes (220-230) may be removed from the plant by mechanical conveying, water flumming, or manual operations. It is quite

convenient to remove most of the "preparation" waste by water-fluming — the method chosen for the proposed layout.

An assumption has been made that the solid wastes will be hauled to a dump or to a garbage disposal plant.

For a plant located outside of town, liquid wastes preferably will be disposed into large running streams, irrigation ditches, seepage ponds, lagoons, or waste land, depending upon what is available and upon local and State regulations.

BUILDINGS AND GROUNDS

Buildings and grounds for a cranberry dehydration plant should conform with the general requirements described in Volume I under "Plant Location" and "Selection of Plant Procedures and Facilities". The cranberry plant depicted herein requires a minimum of one acre of land; more acreage would be advisable in many cases.

Figure 3 shows a suggested plant layout. A receiving area in the main building has been provided for holding approximately a week's supply of raw material. If the plant is located where weather conditions might be severe for longer periods, this area probably should be larger.

The"preparation" area is separated from the "receiving" area to minimize noise, dust, and drafts from outside air. Floor drains should be provided across the "preparation" area, along the tray stacking and slicing line, at the turntables, and at each of the two transfer tracks.

Space is provided in front of the tunnels for storing loaded trucks of sliced cranberries. (This space is needed if it is desired to operate the "preparation" line on a two-shift basis and the tunnels on a three-shift basis.) The space at the discharge end of the tunnels is smaller, based on the premise that the dried cranberries will be unloaded within a short time after leaving the tunnels.

The various processing steps are located to permit ready expansion within the area provided. The bin room, the drying tunnel area, the inspection and packaging room, the finished material storage area, and the raw cranberry storage area may be expanded away from the plant proper without interfering with the processing line.

The bin drying, inspection, and packaging areas are all on one floor. Sufficient space has been provided for installing the equipment plus adequate handling areas.

The boiler room is shown as a part of the main building to permit a reasonably short length of steam pipes to the bin drying room. If the boiler is located at some distance from the plant, a saving in fire insurance rates might be possible, but steam transmission losses would be higher.

The locations of the offices, laboratory, rest rooms, and lunch room are only suggestive. These could be rearranged without seriously affecting plant operation.

INFORMATION CONCERNING MANUFACTURE OF DEHYDRATED CRANBERRY POWDER (TYPE I)

One processor has produced powdered cranberries for military consumption. A brief description of the process and equipment used is as follows:

Graded cranberries are purchased through the National Cranberry Association. The berries are washed, and then cooked in a continuous steam-jacketed screw conveyor (12" diameter by 12 feet long) for approximately six minutes (steam pressure on jacket 55 p.s.i.). The cooked berries are put through a pulper or finisher, and the resulting puree or juice is stored in a tank feeding the drum driers. Two stainless steel drum driers 6' x 10' long, operating at 2 to 14 r.p.m., reduce the moisture to less than 5%. Each drum has a drying capacity of 600 pounds of product per hour. The product is packaged in one-pound cans. The normal shrinkage ratio for this product is about the same as for dehydrated slices (10 : 1).

CHAPTER IV

COST OF CRANBERRY DEHYDRATION FACILITIES
(Packaging in One-Pound Cartons)

Cost Summary

100 -- RAW MATERIAL PROCUREMENT FACILITIES		
170 -- "Crates, Boxes, & Sacks" (crates)	$ 7,000	
Total for RAW MATERIAL PROCUREMENT FACILITIES		$ 7,000
200 -- MANUFACTURING OPERATIONS FACILITIES		
210 -- "Raw Material Handling" Equipment	8,790	
220-230 -- "Preparing" Equipment	6,560	
240 -- "Drying" Equipment	80,265	
250 -- "Screening & Inspecting" Equipment	2,860	
260 -- "Packaging & Packing" Equipment	42,230	
270 -- "Warehousing & Shipping" Equipment	600	
Total for MANUFACTURING FACILITIES		$141,305
GENERAL FACILITIES		
320 -- "Utilities" Equipment	16,710	
330 -- "Maintenance & Repairs" Equipment & Supplies	8,000	
380 -- "Inspection & Control" Equipment & Supplies	3,500	
390 -- "Miscellaneous Plant" Equipment	3,050	
400 -- "Automotive" Equipment	3,500	
690 -- "Office & First Aid" Equipment & Supplies	2,500	
Total for GENERAL FACILITIES		$ 37,260
Total for Plant Equipment (TABLE I)		185,565
Total for Buildings & Grounds (TABLE II)		130,000
Construction Engineering Fees		20,000
TOTAL COST FOR ITEMIZED PHYSICAL FACILITIES FOR CRANBERRY DEHYDRATION PLANT		$ 335,565

Critical Materials in the Equipment for a 50-Ton Per Day Cranberry Dehydration Plant

Material	Estimated Total No. of Pounds in Equipment	Percentage of Total Weight of Critical Materials
Iron and Steel	100,000	98.2
Copper	900	0.9
Stainless steel	400	0.4
Zinc	300	0.3
Tin	100	0.1
Rubber	100	0.1
Total	101,800	100.0

Disclaimer Statement

The designation of any manufacturer or brand-name equipment does not imply a specific recommendation by the Department of Agriculture. Such inclusion means only that these particular items have been found satisfactory for the purpose indicated; other sources and items may prove equally satisfactory. Additional information concerning suggested manufacturers of equipment may be found in "Additional Sources of Information" (Volume I, Appendix C).

TABLE I—PLANT EQUIPMENT FOR A 50-TON PER DAY CRANBERRY DEHYDRATION PLANT

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
	100 -- RAW MATERIAL PROCUREMENT FACILITIES					
170 -- Crate, Box, & Sack Expense						
	a. Crates: Bushel crates for handling cranberries in the field, plant and storage.	--	50 lbs. capacity; approximate inside dimensions 8-1/3" x 14" x 9-1/2"	14,000	$0.50	$ 7,000
	TOTAL COST OF "RAW MATERIAL PROCUREMENT" FACILITIES					$ 7,000
	200 -- MANUFACTURING OPERATIONS FACILITIES					
210 -- Raw Material Handling						
212 -- Unloading & storing (at plant)						
	a. Lift truck: To unload and move palletized loads of raw cranberries and empty crates within the plant	Yale Model KG 51-T-40-U (7,300 lbs)	Capacity 2 tons; gasoline engine	1	4,100	4,100
	b. Pallets: For handling of raw material from supply storage to plant storage and receiving station and within plant	--	Wood; 48" x 60"; double-faced	250	4	1,000
213 -- Feeding to line						
	a. Elevator: To serve as a dumping point for crated raw material and to elevate cranberries to conveyor	FMC 1/ Figure 542 (1,570 lbs)	Gooseneck conveyor-elevator; width 16"; discharge height 12', floor length 14' 6-3/4"; complete with 1 h.p. motor drive	1	875	875
	b. Conveyors: To convey raw material from elevator to washer	FMC Figure 5030 (1,300 lbs)	24" wide x 20' long center-to-center rubber belt distributing conveyor; steel frame construction, belt supported by steel rollers; complete with 1-1/2 h.p. motor	1	1,605	1,605
			Sub-total			$ 7,580
Allowance for Freight Charges (factory-made equipment)		--	11,000 lbs. at 5¢/lb.			550
Allowance for Installation Charges -- 25%		of equipment	cost plus freight ($2,630) 2/			660
	Total Cost of "Raw Material Handling" Equipment					$ 8,790
220-230 -- Preparing						
221 -- Washing						
	a. Washer: To wash cranberries thoroughly without bruising	FMC Figure 1096 Model U (2,500 lbs)	Fruit and berry washer; length overall 12' 9"; width overall 4'; perforated belt width 20"; overall height 5' 2"; including one 1/2 h.p. and one 3/4 h.p. motors	1	1,855	1,855
224 -- Inspecting						
	a. Conveyor: To convey and drain washed cranberries; also for inspection of berries before slicing	FMC Custom built (900 lbs)	24" width x 15' long center-to-center; woven No. 16 wire belt distributing conveyor; steel frame construction; belt supported by steel rollers; with chute to discharge product to slicer; complete with 1-1/2 h.p. motor	1	1,420	1,420
226 -- Cutting (slicing)						
	a. Elevator: To elevate cranberries to slicer	FMC Figure 542 (1,300 lbs)	Gooseneck elevator-conveyor; 16" wide; 8' discharge height; complete with 1 h.p. motor	1	775	775

1/ Food Machinery & Chemical Corporation

2/ Equipment cost based on F.O.B. manufacturer's price plus allowance for freight charges at 5¢/lb. (on items requiring installation)

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
226 -- Cutting (slicing) cont'd.						
b.	Slicer: To slice cranberries to desired thickness	FMC Fig. 988 No. A-1 (400 lbs)	21" disc; 5 knives; improved "Buffalo" Kraut Cutter with stainless steel bowl; complete with motor drive	1	$ 900	$ 900
			Sub-total			$ 4,950
Allowance for Freight Charges (factory-made equipment)			-- 6,000 lbs. at 5¢/lb.			300
Allowance for Installation Charges -- 25% of equipment			cost plus freight ($5,250)			1,310
	Total Cost of "Preparing" Equipment					$ 6,560
240 -- Drying						
241 -- Tunnel drying						
241.1 -- Tray loading						
a.	Tray conveyor: To convey empty trays under slicer for loading; and to convey loaded trays to tray stacker	Custom built (4,000 lbs)	6' wide x 50' long center-to-center; double drag chain conveyor; complete with 3 h.p. variable speed motor drive	1	$ 4,000	$ 4,000
b.	Tray spreader: To load (and spread uniformly) the sliced cranberries on the drying trays	Syntron Model F 44 "Twin" (5,000 lbs)	Two 36" x 36" stainless steel troughs, with magnetic vibrators	1	2,730	2,730
241.2 -- Tray stacking						
a.	Tray stacker: To stack loaded trays on cars	Knipschild Dehydrator Company (4,000 lbs)	Loaded trays are lifted vertically from tray conveyor and moved horizontally until positioned over empty car, then stacked to a height of 25 trays; fully automatic	1	3,600	3,600
241.3 -- Weighing						
a.	Scales: To weigh loaded cars or trucks of trayed cranberry slices	Toledo Model 31-1921-E 76 x 54 FF (1,875 lbs)	Dial type indicating system; 2600 lbs. capacity; 76" x 54" platform; equipped with extension lever to permit location of dial column out of path of cars; installed in pit with the scale platform level with floor	1	980	980
241.4 -- Tunnel operating						
a.	Trays: To hold sliced cranberries from slicer through the drying tunnels	Custom built (See picture)	3' wide x 6' long; wood frame and slat construction	2,500	3	7,500
b.	Tunnel driers: To dry sliced cranberries to 10-12% moisture	Custom built (See figure)	Single stage, counter-flow twin tunnels with necessary heating, circulation and temperature control equipment, trackage, and 95 cars	3 twin single-stage tunnels	--	50,000 3/
241.5 -- Tray unloading & stacking						
a.	Tray scraper: To remove dried cranberries from trays	Knipschild Company (1,500 lbs)	Trays are manually removed from cars and turned over a revolving wire brush which loosens product from trays. Product falls into hopper	1	1,400	1,400
241.6 -- Elevating & conveying						
a.	Elevator: To lift dried product from tray scraper bin to conveyor loading portable drying bins	FMC Fig. 541 (1,000 lbs)	Gooseneck conveyor-elevator; discharge height 8 feet; 12" wide buckets; complete with 3/4 h.p. motor	1	600	600
b.	Conveyor: To move dried cranberries from elevator to bin-loading station	FMC Fig. 5030 A (1,500 lbs)	18" wide x 25' long center-to-center; rubber belt conveyor; complete with 1-1/2 h.p. motor	1	1,885	1,885
			Sub-total			$ 72,695
Allowance for Freight Charges (factory-made equipment)			-- 19,000 lbs. at 5¢/lb.			950
Allowance for Installation Charges -- 25% of equipment			cost plus freight ($16,145)			4,035
	Total Cost of "Tunnel Drying" Equipment					$ 77,680

3/ Cost installed - based on estimates from Bloxham Engineering Co., Basalt Rock Co., and other sources.

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
248 -- Bin drying						
248.1 -- Bin loading						
a.	Portable bins: To hold product during final drying stage and to equalize moisture	Custom built (See Fig. 7)	4' wide x 8' long x 5' high; sheet metal or plywood construction; mounted on casters and equipped with ring for dumping by means of hoist; bronze 8-mesh screen supported by 1/2" backing screen as false bottom; 10" diameter air inlet duct	10	$ 75	$ 750
248.2 -- Bin operating						
b.	Blowers: To circulate air through heating coils and drying bins	Sturtevant Silentvane No. 60 Design 10 Class II (290 lbs)	Single width; bottom horizontal discharge; 4,000 c.f.m. at 5" s.p.; 2,430 r.p.m.; including 5 h.p. motor & drive	1	280	280
c.	Heating coils: To heat air going to drying bins	Aerofin Corp. Type F Non-freeze Coil Series 80 (160 lbs)	Bank of coils, 2 rows deep consisting of two sections No. 82, 10 tube face, 2' 3" tube length	1	155	155
d.	Ducts: To take air from outside of building, conduct it through fan and heating coil, and to each of 5 drying bin positions	Custom built	Horizontal run laid on floor, 30' length, 4 sq. ft. maximum cross-section with 5 outlets on one vertical face, with transition to 10" diameter collars	1	800	800
248.3 -- Bin unloading						
a.	Hoist: To elevate the drying bins for dumping of the dried product	Yale Midget King Electric Hoist Model No. 1E 17 H (150 lbs)	Hook type; 2,000 lbs. capacity; 10 ft. lift; 17 f.p.m.; 1 h.p.	1	360	360
			Sub-total			$ 2,345
Allowance for Freight Charges (factory-made equipment)			-- 600 lbs. at 5¢/lb.			30
Allowance for Installation Charges -- 25% of equipment			cost plus freight ($825)			210
	Total Cost of "Bin Drying" Equipment					$ 2,585
	Total Cost of "Tunnel Drying" Equipment					77,680
	Total Cost of "Drying" Equipment					$ 80,265
250 -- Inspecting						
251 -- Elevating						
a.	Elevator: To lift dried cranberries from bin dumper to inspection belt	FMC Fig. 1771 (670 lbs)	8" bucket elevator; discharge height 12 ft.; complete with 1 h.p. motor with 2:1 variable speed drive	1	1,010	1,010
252 -- Screening (no screening of dried cranberries)						
a.	Magnet: To remove particles of iron and steel from dried product	FMC (Cesco) Plate Magnet (20 lbs)	Steel face plate, 12" wide; standard model	1	90	90
255 -- Inspecting						
b.	Inspection belt: To convey the product past the final inspection station and under heating unit to presses	FMC Figure 560 (1,100 lbs)	10' picking table; 30" wide belt; 28" long x 13" wide receiving hopper; complete with 1 h.p. motor	1	1,090	1,090
			Sub-total			$ 2,190
Allowance for Freight Charges (factory-made equipment)			-- 2,000 lbs. at 5¢/lb.			100
Allowance for Installation Charges -- 25% of equipment			cost plus freight ($2,280)			570
	Total Cost of "Inspecting" Equipment					$ 2,860

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
260 -- Packaging and Packing						
261 -- Filling, packing and sealing						
b.	Heating unit: To warm the product prior to compression	Custom built	Bank of 36 infra-red lamps, 350 watts each, mounted in insulated hood over conveyor belt	1	$ 200	$ 200
c. & d.	Filling, weighing & compression machine: To weigh, compress, and eject block of compressed dehydrated cranberries	Custom built Pneumatic Scale Corp. Ltd. (4,700 lbs each)	Design of A. D. Makepeace Co., to handle blocks 4-1/4" x 4-1/2" x 2-3/4" and/or blocks for No. 2-1/2 cans	2	10,000	20,000
g.	Closing machine (seamer) (For cartons): To seal the covers on 5-gallon cans	American Can Co. Model 14 (920 lbs)	Semi-automatic machine; 10 cans per minute; double or single seam opening pry-off lid	1	770	770
h.	Roller conveyor (For cartons): To convey packed 5-gallon cans from wax coater to seamer	Standard Conveyor Company (40 lbs)	Standard roller conveyor; 16" rollers spaced 4-1/2" centers; overall length 5'	1	20	20
i.	Belt-compression sealer (For cartons): To seal cartons	Stokes & Smith Co. (1,850 lbs)	2' 6" wide x 22' long; double unit for top and bottom sealing of cartons; for carton size 4-1/4" x 2-3/4" x 4-1/2"; complete with drive	1 double unit	1,600	1,600
j.	Wax coater (For cartons): To wax dip and cool sealed cartons	Greer Wax Coater (3,600 lbs)	Stainless steel belt troughs; 12" packing boards; feed table - 1/2" mesh wire belt 16-5/8" wide; coater belt 3/8" mesh wire belt 16-5/8" wide; cooling conveyor - 18" wide endless neoprene belt; packing table 18" wide 2-ply canvas belt; variable speed drive	1	10,000	10,000
k.	Check weight scale: To check-weigh cartons or No. 2-1/2 cans	FMC Fig. 2152 Scale No. 1-C-74-05 (30 lbs)	General purpose scale: 5" width, 14" depth, 16" height, 6" x 6" x 1" plate, size capacity 3 lbs x 1/4 oz.	1	80	80
263 -- Case forming, filling, sealing, & marking:						
a.	Stenciller: To cut stencils for addressing cased products	FMC Ideal Stencil Cutting Machine Model 1 Fig. 8046 (180 lbs)	Letter-size 1"; number of lines 4	1	250	250
c.	Roller conveyor: To convey 5-gallon cans from seamer to casing station; cases to pallet loading station; and cased No. 2-1/2 cans from casing station to pallet loading station	Standard Conveyor Company (5'- 40 lbs) (10'-80 lbs)	Set consisting of: standard conveyor 16" rollers, 4-1/2" centers, standard 5' and 10' lengths	1 set	50	50
			Sub-total (For cartons)			$ 32,970
Allowance for Freight Charges (factory-made equipment)			-- 17,000 lbs. at 5¢/lb.			850
Allowance for Installation Charges -- 25% of equipment			cost plus freight ($33,620)			8,410
			Total Cost of "Packaging and Packing" Equipment			$ 42,230
270 -- Warehousing & Shipping						
a.	Pallets: For handling empty cans and filled cases	--	Wood 48" x 60", double-face	150	4	600
			Sub-total (Warehousing & Shipping)			$ 600
Allowance for Installation Charges						None
			Total Cost of "Warehousing & Shipping" Equipment			$ 600
			TOTAL COST OF "MANUFACTURING OPERATIONS" FACILITIES			$141,305

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
			GENERAL FACILITIES			
320 -- Utilities						
321 -- Water supply						
a.	Water pump: To elevate water from well and deliver it throughout plant at required pressure	FMC Peerless Deepwell Turbine Type Pump (3,130 lbs)	100 g.p.m. at 80 p.s.i.; 100 ft. head; complete with 10 h.p. motor	1	$ 1,620	$ 1,620
c.	Water well: For supplying water sufficient to meet needs of plant	--	Cost includes digging and casing of well and small housing for pump motor	1	2,000	2,000
322 -- Fuel supply						
b.	Oil storage tank: Storage of #1 stove oil fuel for tunnels and boiler	Standard Construction (12,000 lbs)	15,000 gal. capacity, for underground storage; including pump, pipe, and accessories	1	2,000	2,000
324 -- Steam supply						
a.	Steam boiler: To supply steam for operation of plant equipment, cleanup, building heating, etc.	Cleaver-Brooks Model LR-400-8 (8,900 lbs)	Four-pass horizontal fire-tube boiler with integral channel iron frame and burner assembly; 80 boiler horsepower rating, 125 p.s.i. design pressure; equipped for burning No. 6 fuel oil or No. 1 stove oil, and gas; includes 3 h.p. blower motor, 1/3 h.p. spinner motor and 1/3 h.p. oil supply motor feed pump and condensate tank; complete package unit	1	6,950	6,950
			Sub-total			$ 12,570
Allowance for Freight Charges (factory-made equipment)			-- 24,000 lbs. at 5¢/lb.			1,200
Allowance for Installation Charges -- 25% of equipment			cost plus freight ($11,770)			2,940
			Total Cost of "Utilities" Equipment			$ 16,710
330 -- Maintenance & Repairs 4/						
a.	Maintenance shop equipment: To maintain plant equipment in proper operating condition; to make necessary repairs	--	Includes welding and cutting equipment; drill press; cut-off saw; grinder; electric and carpenter benches; miscellaneous hand tools and supplies	-	--	$ 3,000
b.	Maintenance parts & supplies: Standing inventory of spare parts and maintenance supplies to assure continuous operation of plant	--	Pipe, sheet metal fittings, electric motors, equipment parts, welding supplies, etc.	-	--	5,000
			Total Cost of "Maintenance & Repairs" Equipment and Supplies			$ 8,000
380 -- Inspection and Control 4/						
381 -- Laboratory testing						
a.	Laboratory equipment and supplies: To do necessary control testing of processing operations and of finished products	--	Apparatus, supplies, tables, books, benches and other facilities needed for test and control purposes	-	--	$ 3,500
			Total Cost of "Inspection and Control" Equipment and Supplies			$ 3,500
390 -- Miscellaneous Plant Equipment 4/						
a.	Lunch room: To accomodate 30 people at a time	--	--	-	--	$ 2,400
b.	Fire-fighting equipment: For emergency use	--	2 - 150 ft. hoses and reels; 2 emergency showers; 4 5-gal. extinguisher tanks; 6 hand extinguishers; 6 gas maskes; 6 fire helmets	-	--	650
			Total Cost of "Miscellaneous Plant" Equipment			$ 3,050

4/ Costs indicated for these items include installation costs

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
400 -- Automotive Equipment						
a.	Truck: For miscellaneous hauling	GMC	1-1/2 ton pick-up truck (delivered price)	1	$ 3,500	$ 3,500
	Total Cost of "Automotive" Equipment					$ 3,500
690 -- Miscellaneous Administrative Supplies and Facilities 4/						
a.	Office furniture, supplies, and first-aid facilities: For bookkeeping, pay rolls, personnel work, business transaction, first aid, etc.	--	--	-	--	$ 2,500
	Total Cost of "Miscellaneous Administrative Supplies & Facilities"					$ 2,500
	TOTAL COST OF "GENERAL" FACILITIES					$ 37,260

TABLE II

BUILDINGS AND GROUNDS FOR A CRANBERRY DEHYDRATION PLANT

	Building & Grounds: Suitable building and grounds for the cranberry dehydration plant	--	Includes: land; a building complete with industrial lights, utility and sewer lines within the building, toilet facilities and loading ramps (or platform)			
			Building - 26,000 sq. ft. at $5/sq. ft.			$130,000
	TOTAL COST OF BUILDING AND GROUNDS					$130,000

TABLE III

OPTIONAL EQUIPMENT FOR A CRANBERRY DEHYDRATION PLANT

260 -- Packaging and Packing						
261 -- Filling, packing, and sealing						
g.	Closing machine (seamer) (For No. 2-1/2 cans): To seal the covers on No. 2-1/2 cans	American Can Co. (1,050 lbs)	Semi-automatic machine operated by depressing foot treadle for each seaming operation. Includes 1-1/2 h.p. motor	1	$ 850	$ 850
h.	Can conveyor (For No. 2-1/2 cans): To move cans from feeding station to filling station and discharge table	FMC (650 lbs)	6" wide x 15' long (center-to-center) impregnated fabric belt supported on zig-zag half-round bars; including stops, discharge table, and feed shelf; complete with 1/2 h.p. motor	1	860	860
320 -- Utilities						
321 -- Water supply						
a.	Diesel engine: For standby use for operating the well water pump	Fairbanks-Morse Co.	Diesel engine complete with fuel tank and connecting gears for attaching to well water pump. Cost for this standby service is in addition to the cost of pump equipment listed	1	1,000	1,000
394 -- Miscellaneous						
a.	Hand trucks, auxiliary tables and other similar equipment	--	--	-	--	3,000
	TOTAL COST FOR "OPTIONAL" FACILITIES					$ 5,710

4/ Costs indicated for these items include installation costs

Chapter V

PRODUCTION COSTS FOR A 50-TON PER DAY CRANBERRY DEHYDRATION PLANT

Table I -- Summary of Cost of Producing Dehydrated Cranberries
(Assuming Different Raw Material Costs and Shrinkage Ratios)
(Packaging in One Pound Cartons)

Overall-shrinkage ratio of:			9 to 1	10 to 1	12 to 1
Output of finished product per day (lbs.)			11,110	10,000	8,330
			Production Cost per Pound of Product		
Processing Cost - from Table II			$0.2418	$0.2578	$0.2897
Assumed Cost for 50 tons of Raw Material Entering Processing Line					
At $100 a ton	($5.00 a barrel)	$5,000 a day	$0.4500	$0.5000	$0.6000
150	(7.50)	7,500	0.6750	0.7500	0.9000
200	(10.00)	10,000	0.9000	1.0000	1.2000
250	(12.50)	12,500	1.1250	1.2500	1.5000
300	(15.00)	15,000	1.3500	1.5000	1.8000
600	(30.00)	30,000	2.7000	3.0000	3.6000
Assumed Production Cost at Various Costs of Raw Material 1/					
At $100 a ton			$0.6918	$0.7578	$0.8897
150			0.9168	1.0078	1.1897
200			1.1418	1.2578	1.4897
250			1.3668	1.5078	1.7897
300			1.5918	1.7578	2.0897
600			2.9418	3.2578	3.8897
Estimated Depreciation Charge (See Table X)					
Assuming plant operates only on cranberries:					
Normal life expectancy			$0.0140	$0.0155	$0.0186
Accelerated write-off			0.0456	0.0507	0.0608
Assuming plant operates half time on another product:					
Normal life expectancy			$0.0070	$0.0078	$0.0093
Accelerated write-off			0.0228	0.0253	0.0304

1/ Exclusive of Depreciation Charges

Table II -- Processing Cost Summary Using 3 Different Overall Shrinkage Ratios
(Depreciation not included)
(Cranberry Dehydration Plant)

	9 to 1 (Low)	10 to 1 (Average)	12 to 1 (High)
Input - lbs. per day raw commodity	100,000	100,000	100,000
Output - lbs. per day of finished product (Type II Sliced Cranberries) 7% moisture	11,110	10,000	8,330
Total daily processing cost based upon cost calculation using a 10 to 1 overall-shrinkage ratio	$2,578	$2,578	$2,578
Adjustment for labor -			
Deduct 17% of labor cost ($352) for inspecting, packaging & packing, and warehousing & shipping			- 60
Add 11% of labor cost ($352) for inspecting, packaging & packing, and warehousing & shipping	+ 39		
Adjustment for packaging supplies -			
Deduct total packaging supply cost based upon 10 to 1 shrinkage ratio (Table III)	- 631		- 631
Add cost applicable to shrinkage ratio (pounds x $0.0631)	+ 701		+ 526
Adjusted processing cost 1/	$2,687	$2,578	$2,413
Cost per pound of product	$0.2418	$0.2578	$0.2897

1/ For purposes of this illustration, it is assumed that all costs per day would be constant for the various yields except the two cost items adjusted. In actual practice, however, costs would be more variable as a result of the different shrinkage ratios

Table II-A -- Calculation of Unit Costs of Processing for Various Shrinkage Ratios
(Assuming constancy of cost except as calculated in Table II
(Cranberry Dehydration Plant)

	9 to 1		10 to 1		12 to 1	
	Daily Cost	Per Pound	Daily Cost	Per Pound	Daily Cost	Per Pound
Pounds output per day	11,110		10,000		8,333	
Raw material procurement	$ 77	$0.0069	$ 77	$0.0077	$ 77	$0.0058
Direct labor cost	863	0.0777	824	0.0824	764	0.0917
Manufacturing expense	1,497	0.1347	1,427	0.1427	1,322	0.1587
Packaging supplies and expenses	701	0.0631	631	0.0631	526	0.0631
Other manufacturing expenses	796	0.0716	796	0.0796	796	0.0956
General and Administrative Expense	250	0.0225	250	0.0250	250	0.0300
Total	$2,687	$0.2418	$2,578	$0.2578	$2,413	$0.2897

Table III -- Processing Cost Summary for Cranberry Dehydration Plant
(Packaging in Pound Cartons)

Account No.		Table No. Reference	Processing Cost Per 24-hour Operating Day	Processing Cost Per Pound Dry Product
Output of finished product per day (10 to 1 overall shrinkage ratio)		II	10,000 pounds	
800 -- Total Cost of Finished Product (exclusive of depreciation and raw material purchase price)			$2,578	$0.2578
100 -- Raw Material Cost (exclusive of purchase price)		IV	$ 77	$0.0077
120	- Buying Expense		47	0.0047
180	- Federal-State inspection		30	0.0030
200 -- Direct Labor		V	$ 824	$0.0824
210	- Raw Material Handling		80	0.0080
220-230	- Preparing		162	0.0162
240	- Drying		230	0.0230
250	- Inspecting		137	0.0137
260	- Packaging and Packing 1/		195	0.0195
270	- Warehousing and Shipping		20	0.0020
300 -- Manufacturing Expense			$1,427	$0.1427
310	- Indirect Labor	VII	146	0.0146
320	- Utilities	VIII	325	0.0325
330	- Maintenance and Repairs	IX	130	0.0130
340	- Depreciation (not included)	X	---	------
350	- Taxes and Insurance	XI	84	0.0084
370	- Packing Supplies and Expenses 2/	XII	631	0.0631
380	- Inspection and Control	XIII	61	0.0061
390	- Miscellaneous Plant Expenses	XIV	50	0.0050
600 -- General and Administrative Expenses		XV	$ 250	$0.0250
610	- Office Salaries		117	0.0117
620-690	- Miscellaneous Expenses		133	0.0133

1/ Cost of labor for packaging one pound cartons and wax-dipping. For packaging in #2 1/2 cans, labor cost is $166 a day or $0.0166 a pound.

2/ Cost of packaging supplies for packing in cartons. For packing in #2 1/2 cans, the cost would be $504 a day, or $0.0504 a pound.

Table IV -- Raw Material Cost (Account 100)
(Cranberry Dehydration Plant)

Account No.			Annual Cost	Cost per Operating Day 1/
100 -- Total Raw Material Cost (excluding purchase price of raw material)			$7,728	$77
110 - Purchase Price			-----	---
The purchase price of raw material is not included here as a cost. See Table I for calculation of raw material costs at various purchase prices per ton				
120 - Buying Expense			4,728	47
Salary of field agent for 6 months 2/	$7,000	$3,500		
Social security, workmen's compensation and unemployment insurance - 6.52%		228		
Expenses - travel, telephone, etc. (estimated)		1,000		
130 - Field Grading			-----	---
Assumed cost of any grading done on cranberries before they are received at dehydration plant is included in price paid for raw commodity				
150 - Transportation and Weighing Cost			-----	---
Included in Table I as part of assumed prices paid for raw commodity				
160 - Storage			-----	---
No outside storage costs are assumed for this study. There will be many instances, however, where storage costs may be incurred and will become an item of expense.				
170 - Crate, Box, and Sack Expense			-----	---
Cost not included here. On the basis of a cost of $7,000 for crates and a five-year life, the annual charge would be $1,400.				
180 - Federal-State Inspection			3,000	30
One inspector 100 days @ $30				

1/ Assumed to be 100 days a year

2/ Because of short operating season, it is assumed only 1/2 of field man's salary is charged to cranberries.

Table V -- Direct Labor Cost Summary (Account 200)
(Cranberry Dehydration Plant)

Account No.		Per 24-Hour Operating Day: Direct Labor Cost Per Day 1/	Add Labor Expense 21% 2/	Total Direct Labor Cost
200	- Total Direct Labor Cost	$681	$143	$824
210	- Raw Material Handling	66	14	80
220-230	- Preparing	134	28	162
240	- Drying	190	40	230
250	- Inspecting	113	24	137
260	- Packaging and Packing (cartons) 1/	161	34	195
270	- Warehousing and Shipping	17	3	20
1/	- Packaging and Packing (2 1/2 cans)	115	24	139

1/ From Table VI

2/ In addition to the "Direct Labor Cost per Day" the following items are additional costs that must be paid by the employer:

		Percentage to apply to calculated labor cost
a.	Overtime - All hours per week over 40 are paid for at one-and-one-half times the basic rate. The work week is 48 hours, making 8 hours to be paid at overtime. Thus the employee receives 12 hours pay for 8 hours. For the week he gets 52 hours pay for 48 hours work (52/48) - 1.0 = 0.08333	8.33%
b.	Swing and night shift differential may amount to 5¢/hr. This may give an average differential of 2.5% on 3-shift basis	2.50
c.	Social security - Paid by employer	1.50
d.	Unemployment insurance - For a new, highly seasonal business, the rate would be	2.70
e.	Workmen's compensation	2.32
f.	Vacation pay - none calculated. A typical union contract provides for vacation with pay after the end of the year in which an employee has worked 1600 hours or more. On a 100-day operation, the total would be only 800 hours	----
g.	Holiday pay - Practices vary with respect to payment for holidays which occur during work week. Since some union contracts provide for such pay, even when the employee does not work, allowance is made here for such cost	3.00
	Round off to	21%

Table VI — Direct Labor Cost Work Sheet (Account 200)
(Cranberry Dehydration Plant)

Account No.	Operation	Number of Employees per Shift Men	Number of Employees per Shift Women	Hourly Rate of Pay Pay Bracket	Hourly Rate of Pay Amount	Total Hours per Shift	Total Cost per Shift	Total Cost per 24-hour Operating Day
200	TOTAL DIRECT LABOR COST	12	16				$226.93	$680.80
210	Raw Material Handling	2 1/4	-				22.00	66.00
	Foreman 1/	1/2		1	$1.50	4	6.00	
	Operating lift truck 2/	3/4		3	1.20	6	7.20	
	Feeding to line	1		4	1.10	8	8.80	
220-230	Preparing	1 1/2	4 1/4				44.80	134.40
	Foreman 1/	1/2		1	1.50	4	6.00	
	Floorlady 3/		1/4	5	1.00	2	2.00	
	Inspecting		4	6	.90	32	28.80	
	Cleaning up, helping	1		5	1.00	8	8.00	
240	Drying	4	4 1/4				63.33	190.00
241	Tunnel drying	2 1/2	4 1/4				47.73	143.20
	Foreman 4/	1/2		1	1.50	4	6.00	
	Floorlady 3/		1/4	5	1.00	2	2.00	
	Loading trays		2	6	.90	16	14.40	
	Operating tunnels	1		3	1.20	8	9.60	
	Unloading trays and restacking		2	6	.90	16	14.40	
	Sub-total						46.40	139.20
	Tray washing and repair 5/	(3)		5	1.00	24	24.00	4.00
248	Bin Drying	1 1/2	-				15.60	46.80
	Foreman 4/	1/2		1	1.50	4	6.00	
	Handling bins, utility	1		3	1.20	8	9.60	
250	Inspecting	3/4	4 1/4				37.80	113.40
	Foreman 6/	1/4		1	1.50	2	3.00	
	Floorlady 3/		1/4	5	1.00	2	2.00	
	Inspecting		4	6	.90	32	28.80	
	Cleaning up 7/	1/2		5	1.00	4	4.00	
260	Packaging and Packing (cartons)	3	3 1/4				53.60	160.80
	Foreman 6/	1/2		1	1.50	4	6.00	
	Floorlady 3/		1/4	5	1.00	2	2.00	
	Operating press, wax dipper	1		3	1.20	8	9.60	
	Filling cartons, sealing tops		1	5	1.00	8	8.00	
	Sealing bottom of cartons		1	6	.90	8	7.20	
	Packing cartons in cans and sealing cans		1	5	1.00	8	8.00	
	Strapping cases and stacking	1		4	1.10	8	8.80	
	Cleaning up 7/	1/2		5	1.00	4	4.00	
270	Warehousing & Shipping	1/2	-				5.40	16.20
	Foreman 6/	1/4		1	1.50	2	3.00	
	Operating lift truck 2/	1/4		3	1.20	2	2.40	
260	Packaging and Packing (#2 1/2 cans)	3	1 1/4				38.40	115.20
	Foreman 6/	1/2		1	1.50	4	6.00	
	Floorlady 3/		1/4	5	1.00	2	2.00	
	Operating press	1		3	1.20	8	9.60	
	Sealing and casing cans		1	5	1.00	8	8.00	
	Strapping and stacking cases	1		4	1.10	8	8.80	
	Cleaning up 7/	1/2		5	1.00	4	4.00	

1/ One foreman for raw material handling and preparing
2/ One lift truck operator for raw material handling and warehousing & shipping
3/ One floorlady for all operations using women
4/ One foreman for all drying operations
5/ Tray washing and repair done only on Sunday - charge 1/6 of cost to each operating day
6/ One foreman for inspecting, packaging, and warehousing & shipping
7/ One cleanup man for inspecting and packaging

Table VII -- Indirect Labor (Account 310)
(Cranberry Dehydration Plant)

Account No.	Number of Employees	Assumed Yearly Rate	Hourly Rate	Total No. of Hours Employed Annually 1/	Yearly Cost	Cost per Operating Day
310 - Total Indirect Labor					$14,573	$146
Year-round employees					$13,315	
Production Supt.	1	$7,000	-	-	$7,000	
Shift Superintendents	2	6,000	-	-	12,000	
Guards	---	-----	-	-	6,000 2/	
Labor expense - 6.52% 3/					1,630	
					$26,630	
One-half chargeable to cranberries 4/					13,315	
Seasonal employees					1,258	
Boiler operator and oiler	1		$1.30	800	$ 1,040	
Labor expense - 21% 5/					218	

1/ 100 days, 8 hours a day for each employee

2/ The estimate of $6,000 for guard service is based upon an assumption of 16 hours of guard service per day for each day of the year. The number of guards actually employed will depend upon how the guard time is divided among the guards. For example, in a week of 7 days, 16 hours a day, or a total of 112 hours, three guards could divide the time so that each would work about 37 hours

3/ Social security 1.50%
Unemployment insurance 2.70%
Workmen's compensation 2.32%
6.52%

4/ A plant operating only 100 days a year could hardly afford to keep the staff of key personnel on the payroll throughout the year, unless the plant could operate on some other commodity. For the purposes of this estimate, it is assumed that 1/2 of the yearly labor cost for year-round indirect labor is chargeable to cranberry operations.

5/ See Table V for analysis of 21% labor expense

Table VIII - Utilities (Account 320)
(Cranberry Dehydration Plant)

Account No.		Cost per Operating Day
320	**Total Daily Cost of Utilities**	$325
321	**Water supply**	
	100 gallons a minute is estimated need of plant. It is assumed the water will be pumped from company's own well, so cost of pumping is included in cost of power	
322	**Fuel** -	$270
	Boiler	
	50% load on 80-horsepower boiler	
	$\frac{.5 \times 80 \times 33{,}500 \text{ B.T.U./hr.} \times 24}{80\% \text{ efficiency}} = 40{,}000{,}000$ BTU/day	
	$\frac{40{,}000{,}000}{136{,}000 \text{ (B.T.U./gal. of stove oil)}} =$ 300 gallons of stove oil/day	
	Tunnels	
	Average fuel consumption per pair of tunnels — 3,000,000 B.T.U./hr.	
	Average fuel consumption — 72,000,000 B.T.U./day	
	Average fuel consumption for three pairs of tunnels — 216,000,000 B.T.U./day	
	$\frac{216{,}000{,}000}{136{,}000} = 1{,}590$ gallons of stove oil/day	
	Boiler 300 gal. stove oil/day	
	Tunnels 1,600 gal. stove oil/day	
	total 1,900 gal. stove oil/day @ $0.14 = $266	
323	**Electric power**	55
	K.W.	
	Motors 118 h.p. (746 watts per h.p. and 75% use and efficiency factor) — 66	
	Heating apparatus (wax coating) — 19	
	Lights — 30	
	Total K.W. — 115	
	115 x 24 = 2,760 kwh per day @ 2¢ = $55.20	
325	**Waste disposal**	---
	Garbage disposal - None	
	Sewerage charges - none Assume disposal in rural area	

Table IX -- Maintenance and Repairs (Account 330)
(Cranberry Dehydration Plant)

	Total No. of Employees	Hourly Rate Pay Bracket	Hourly Rate Amount	Hours Worked Process Season 1/	Hours Worked Off Season 2/	Total per Employee	Hours for Group	Total Cost Per Year
Labor								
Head mechanic	1	1	$1.50	800	360	1,160	1,160	$1,740
Shift mechanics & oilers	2	2	1.30	800	360	1,160	2,320	3,016
Sub-total	3							$4,756
Labor expense (16%) 3/								761
						Labor Cost		$5,517
Cost of Supplies and Replacements								
Estimated (for entire year)								7,500
Total Cost of "Maintenance and Repairs" for a year								$13,017
Cost per operating day ($13,017/100)								$130

1/ 100 days, 8 hours a day = 800 hours

2/ 9 weeks, 40 hours a week = 360 hours. It is assumed that the mechanics will be employed for maintenance and repair work to make a total of 6 months' employment. (See Table VII, footnote 4/)

3/ Labor expense during processing season 20.29%

Night shift differential: 2 mechanics out of 3 on night shift. At average hourly rate of $1.37, 5¢ an hour differential (0.05)(2)/(1.37)(3)	2.44%
Social security	1.50
Unemployment insurance	2.70
Workmen's compensation	2.32
Vacation pay (included in time for off-season)	----
Holiday pay (see Table V)	3.00
Overtime - 52 hours pay for 48 hours work (see Table V)	8.33

Labor expense during off-season 6.52%

Social security	1.50%
Unemployment insurance	2.70
Workmen's compensation	2.32
Vacation and holiday pay included in regular 40-hour week	----

Calculation of labor expense percentage to apply:

(800 hours with 20.29%)	800 x 0.2029	=	162.32
(360 hours with 6.52%)	360 x 0.0652	=	23.47
		185.79	185.79/1,160 = 16.02%

Table X -- Depreciation (Account 340)
(Cranberry Dehydration Plant)

Depreciation is not included as a cost because of the uncertainty of the write-off period that may be allowed. (See "Business Consideration" in Volume I.) The depreciation charges that would be incurred for this plant (packing in 1-lb. cartons) are calculated below for two possible write-off periods, and for two different assumptions: (1) Plant operating only on cranberries for 100 days, and (2) Plant operating half time on another product so cranberries take only half of annual depreciation charge.

1. Assuming normal life expectancy and probable useful lives (as given in Bulletin F, U.S. Treasury Dept., Bureau of Internal Revenue)

Property Item	Original Cost 1/	Estimated 10% Salvage Value	Cost to be Depreciated	Useful Life (years)	Annual Depreciation Charge
Buildings and Grounds	$135,000	$13,500 2/	$121,500	50	$ 2,430
Crates	7,000	-----	7,000	5	1,400
Equipment	193,565	19,360	174,205	15	11,610
Total	$335,565	$32,860	$302,705		$15,440

Depreciation Charges:

Per operating day $15,440/100 . . . . . $155

	Operation only on cranberries	Half time operation on another product
Per lb. of product at 9:1	($155/11,110) = $0.0140	($155/11,110/2) = $0.0070
Per lb. of product at 10:1	($155/10,000) = 0.0155	($155/10,000/2) = 0.0078
Per lb. of product at 12:1	($155/ 8,330) = 0.0186	($155/ 8,330/2) = 0.0093

2/ Assuming 5-year write-off of 75% of capital investment

Total capital investment	$335,565
Less crates	7,000
	$328,565
75% to be written off	$246,400
Annual charge ($246,400/5)	$ 49,280
Depreciation on crates	1,400
Total depreciation charge	$ 50,680

Depreciation Charges:

Per operating day $50,680/100 . . . . . $507

	Operation only on cranberries	Half time operation on another product
Per lb. of product at 9:1	($507/11,110) = $0.0456	($507/11,110/2) = $0.0228
Per lb. of product at 10:1	($507/10,000) = 0.0507	($507/10,000/2) = 0.0253
Per lb. of product at 12:1	($507/ 8,330) = 0.0608	($507/ 8,330/2) = 0.0304

1/ Includes Engineering Construction Fees (Building and Grounds $5,000; Equipment $15,000.

2/ Includes value of land which is not depreciated

Table XI -- Taxes and Insurance (Account 350)
(Cranberry Dehydration Plant)

Account No.	Cost/Operating Day
350 - Taxes and Insurance Expense	$84
For purposes of this estimate, taxes and insurance on property are combined.	
Packaging in one-pound cartons	
Estimated cost of facilities $335,000	
Taxes and insurance @ 2 1/2% 8,375	
Cost per operating day ($8,375/100)	$83.75
Packaging in # 2 1/2 cans	
Estimated cost of facilities $325,000	
Taxes and insurance @ 2 1/2% 8,125	
Cost per operating day ($8,125/100)	$81.00

Table XII -- Packing Supplies and Expenses (Account 370)

Account No.	Cost/Operating Day
370 - Total Packing Supplies and Expenses (Cartons)	$631
Cartons (One pound of dehydrated cranberries per carton)	
Folding carton, Type A, Class A, kraft-lined, bending chipboard, minimum thickness 0.024" with No. 2 finish 4 1/4" x 2 3/4" x 4 1/2"	
10,000 per day @ $10.20/M	$102
Wax - for wax coating sealed cartons (one pound coats 50-55 cartons)	
10,000/50 = 200 pounds per day @ $0.26 per lb.	52
Cans (17 wax dipped cartons to a 5-gal. can)	
10,000/17 = 588 cans per day @ $398.68/M	234
Cases (Wooden box - to hold two 5-gallon cans)	
588/2 = 294 @ $0.70 each	206
Supplies	
Recipes, straps, etc. estimated	25
Allowance for losses (2% of $619)	12
Total Packing Supplies and Expenses (#2 1/2 cans)	$509
Cans (one pound to a can)	
10,000 cans a day @ $35.11/M	$351
Cases (24 cans to a case) Fiberboard cases	
10,000/24 = 417 cases a day @ $307/M	128
Supplies	
Recipes, straps, glue, etc., estimated	25
Allowance for losses (1% of $504)	5

Table XIII -- Inspection and Control (Account 380)
(Cranberry Dehydration Plant)

Account No.			Annual Cost	Cost/Operating Day
380 - Total Cost, Inspection and Control			$6,075	$61
Salaried Employees:				
Quality Control Technologist		$6,000		
Add Labor Expense (6.52%)		390		
		$6,390		
One-half charged to cranberries			$3,195	
Hourly Employees:				
2 laboratory technicians @ $1.10/hr (1,600 hrs)		$1,760		
Labor expense (21%)		370	2,130	
Supplies & Other Miscellaneous Expenses			750	

Table XIV -- Miscellaneous Plant Expenses & Income (Account 390)
(Cranberry Dehydration Plant)

Account No.	Cost/Operating Day
390 - Miscellaneous Plant Expenses	$50
391 - Lunch room operation - Assumed that sales of meals would offset the lunch room expense	---
393 - Sale of defects, product spilled on floor, etc. Over one-half ton of dry product may be available for sale as feed if a market exists. The material consists of defective pieces removed from the inspection line and of product spilled on floor. No return is estimated, however	---
394 - Other miscellaneous costs (estimated)	50

Table XV -- General and Administrative Expense (Account 600)
(Cranberry Dehydration Plant)

Account No.	Cost/Operating Day
Estimated at $0.025 per pound of product (10,000 x 0.025)	$250

Annual cost (250 x 100) = $25,000

Assuming that the total General Administrative Expense were shared equally between cranberries and some other commodity or function, because of the short (100 day) operating season on cranberries, or that only one-half of the total yearly cost is chargeable to cranberries, the annual cost might be made up as follows:

610 - Salaries	General Manager	$10,000		
	Office Manager	6,000		
	Clerks (2 @ $3,000)	6,000	$22,000	
	Labor expense (6.52%)		1,430	$23,430
620-690 - Other Expenses				26,570
				$50,000
One-half chargeable to cranberries				$25,000

CHAPTER VI

SUMMARY OF CAPITAL AND CREDIT REQUIREMENTS FOR A 50-TON PER DAY CRANBERRY DEHYDRATION PLANT

Fixed Capital and Credit Requirements:			
Plant Equipment		$186,000	
Buildings and Grounds		130,000	
Construction Engineering Fees		20,000	
6-Month General Expense: (From "Production Costs")			
From Table IV - Raw Material Procurement	$4,800		
From Table XIII - Inspection & Control	4,200		
From Table XV - General Administration	25,000	34,000	$ 370,000
Operating Capital and Credit Requirements:			
Estimated Advance Payments to Growers, Insurance, Utilities, etc.		$ 25,000	
75-day Operating Costs ($15,000/operating day) 1/		1,125,000	
25-day Inventory of Manufacturing Supplies (exclusive of raw commodity) ($640/operating day)		16,000	1,166,000
Sub-total			$1,536,000
General Contingency Fund:			
Equivalent to approximately 10% of Estimated Capital Requirements			154,000
ESTIMATED TOTAL CAPITAL AND CREDIT REQUIREMENTS			$1,690,000

1/ Based on 10,000 lbs. dehydrated cranberries (Type II - sliced) per day at an approximate cost of $1.50/lb.)

FIGURE 1 USUAL HARVESTING PERIODS FOR CRANBERRIES BY STATE AND VARIETY

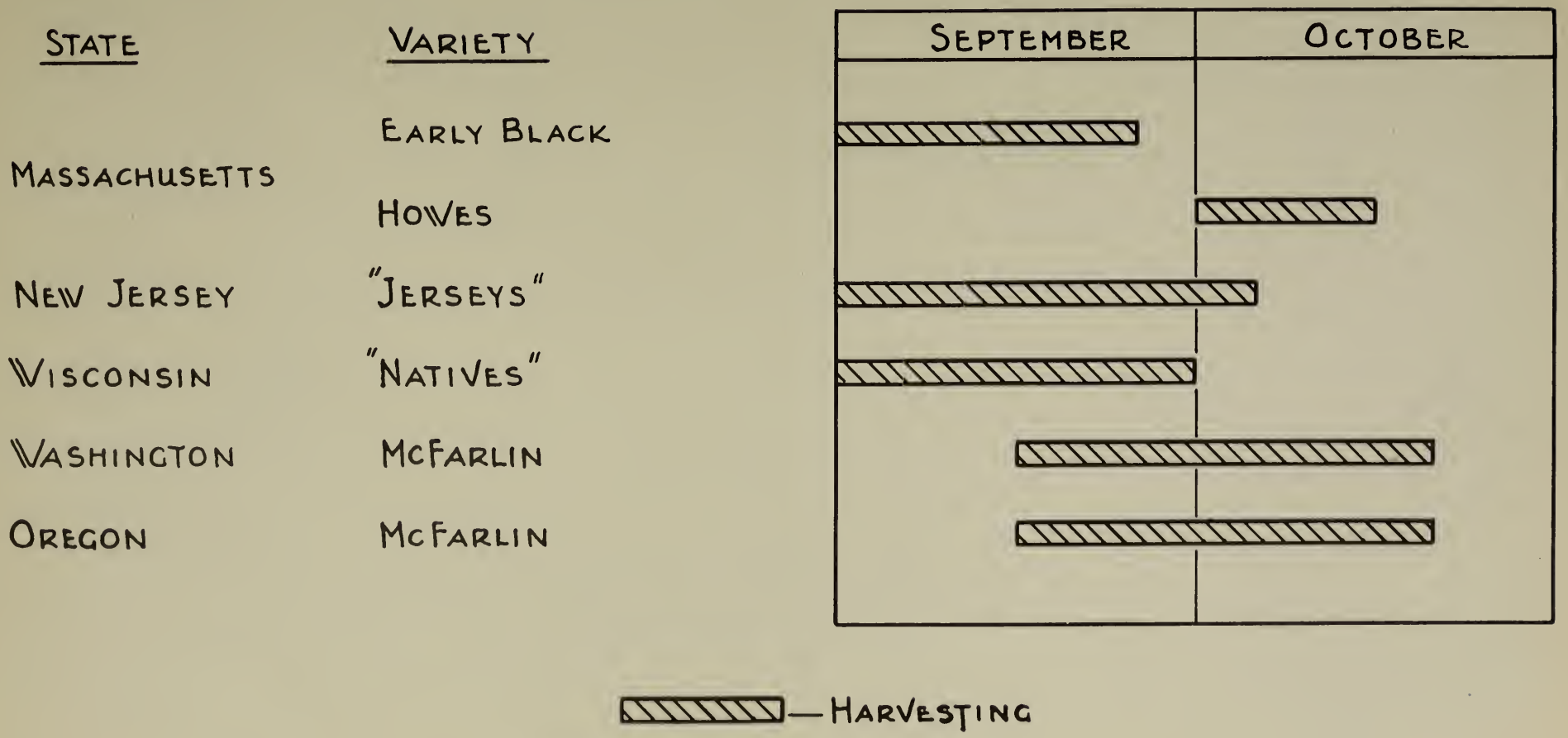
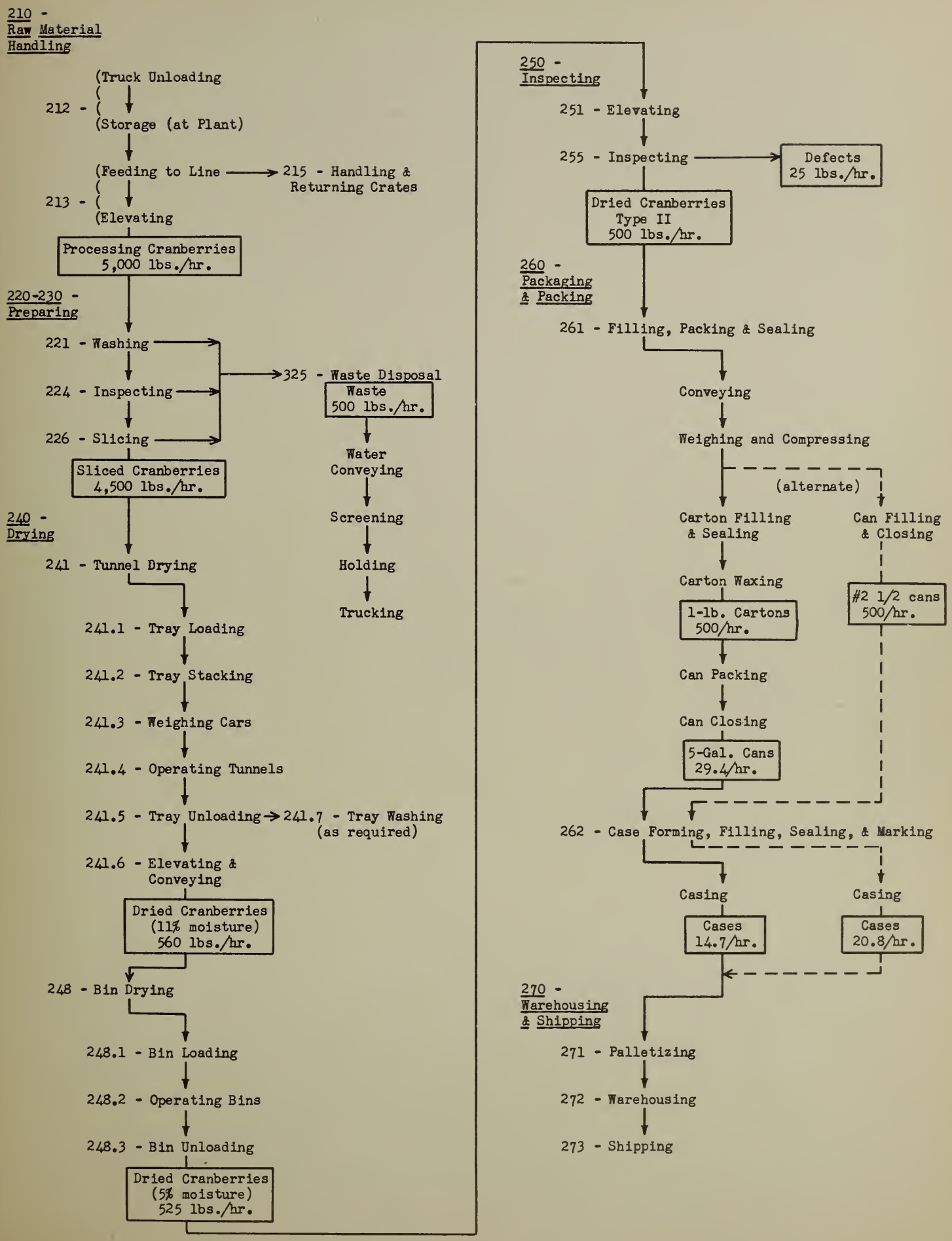


Figure 2 -- FLOW SHEET FOR CRANBERRY DEHYDRATION
(Capacity - 50 Raw Tons per Day)



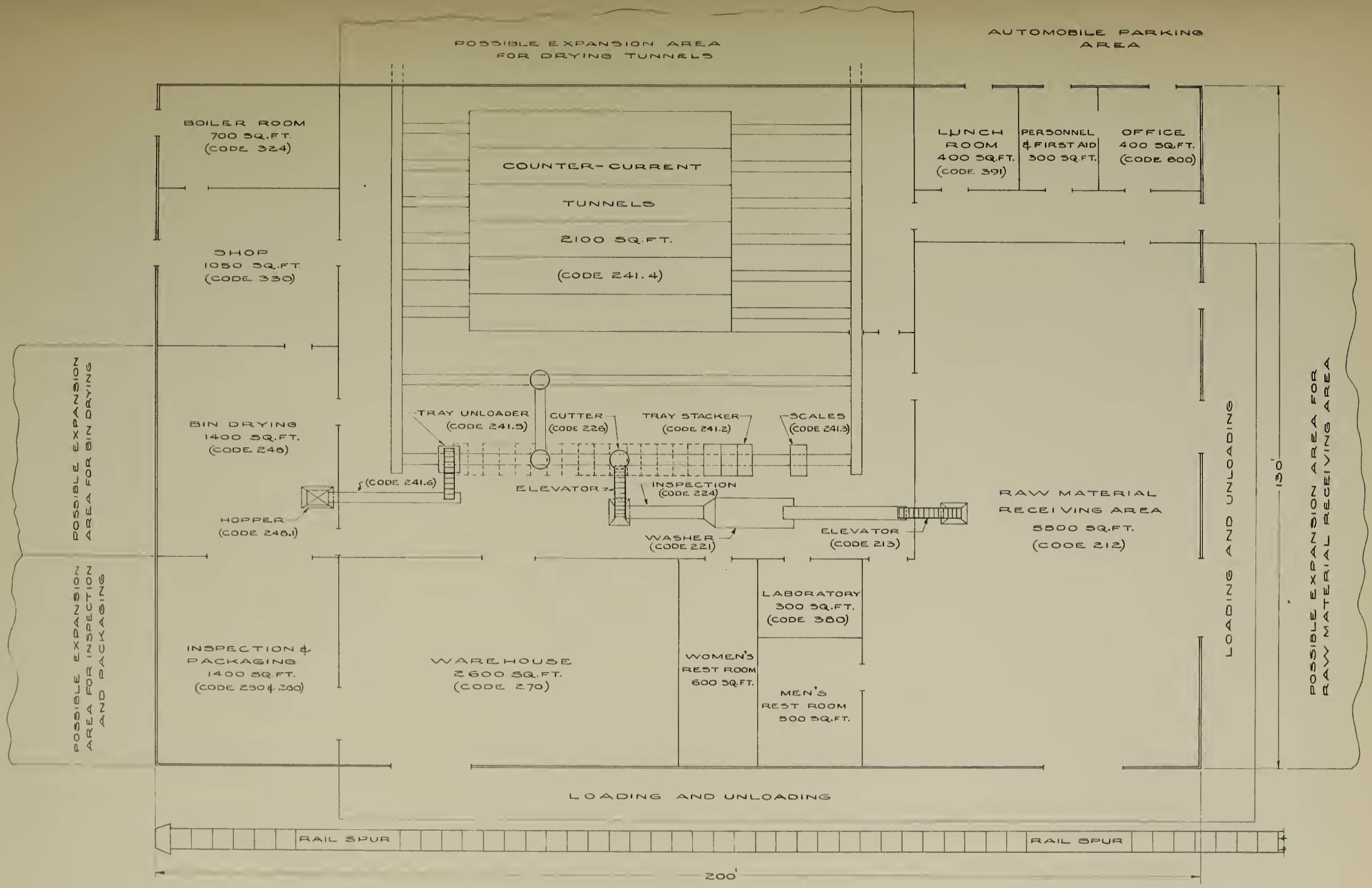
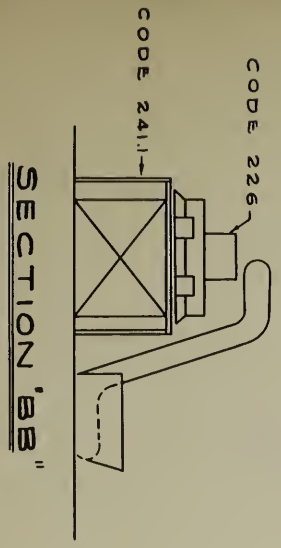


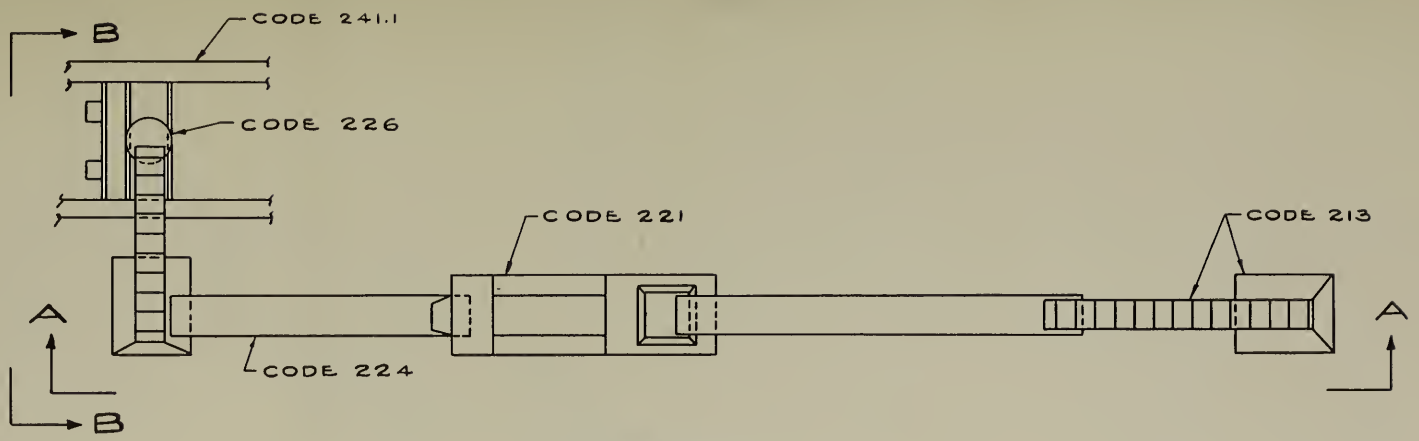
FIGURE 3

PROPOSED FLOOR PLAN FOR CRANBERRY DEHYDRATION PLANT

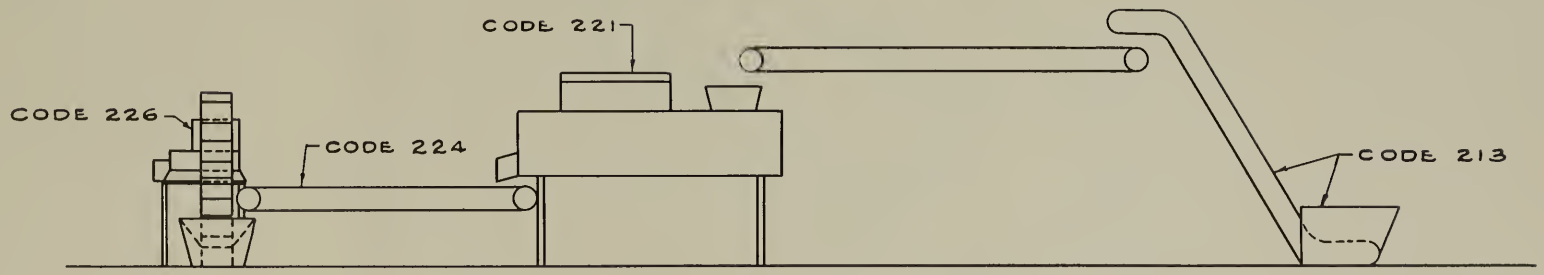
AREA APPROXIMATELY 26000 SQ.FT.



SECTION "BB"



PLAN



ELEVATION - SECTION "A A"

LEGEND

CODE	213	RECEIVING BIN AND ELEVATOR
	221	WASHER
	224	DRAINAGE AND INSPECTION CONVEYOR
	226	SLICER
	241.1	TRAY CONVEYOR

FIGURE 4

PREPARATION LINE FOR
CRANBERRY DEHYDRATION PLANT

GENERAL NOTES.

1. DAMPER TO REGULATE FLOW OF FRESH AIR
2. COMBUSTION CHAMBER
3. BLOWER
4. SHUT-OFF DAMPERS (TWO)
5. SPLITTER DAMPER
6. DAMPERS TO REGULATE FLOW OF RECIRCULATING AIR (TWO)
7. EXHAUST STACKS (TWO)
8. ENTRANCE AND EXIT DOORS (2 SETS)
9. TRAYS OF DRIED PRODUCT LEAVING TUNNEL (ON TRUCKS)
10. TRACKS THROUGH TUNNEL FOR TRUCKS.

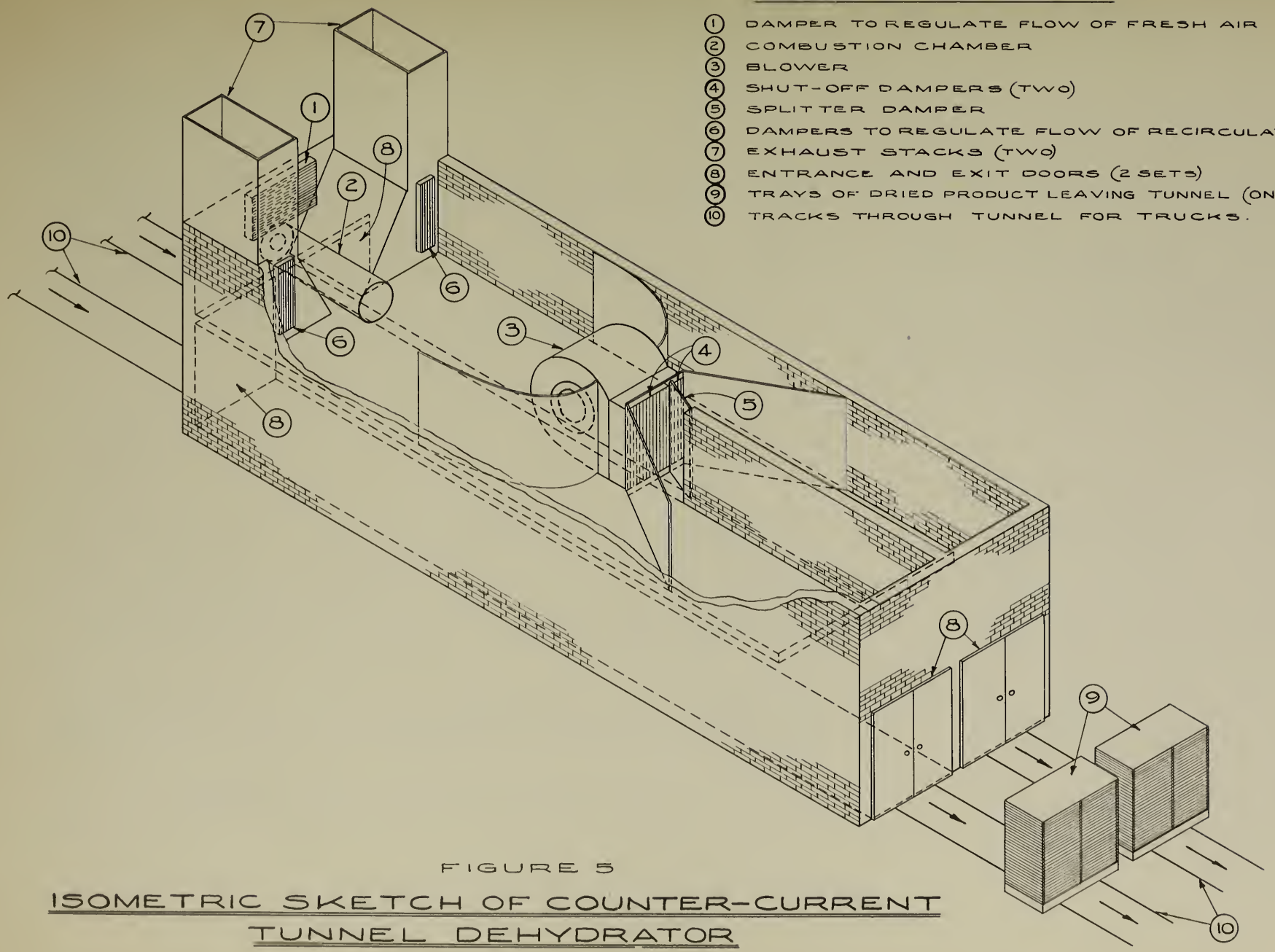
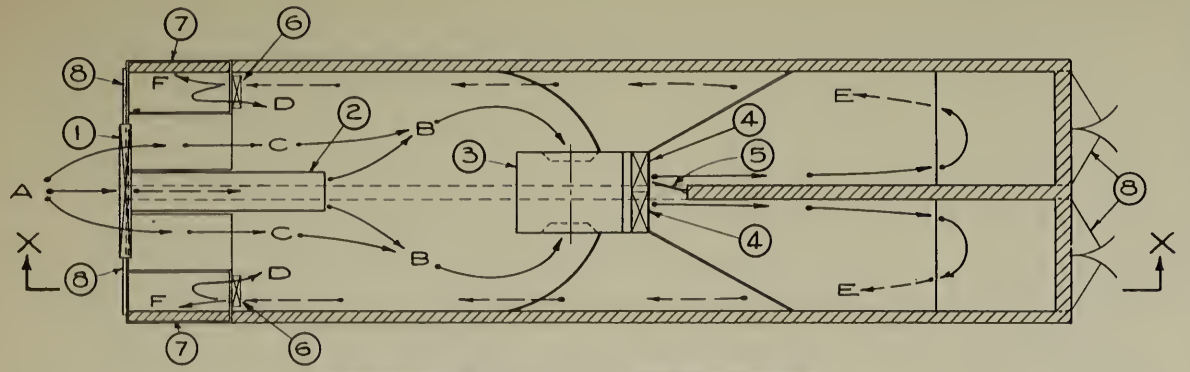


FIGURE 5

ISOMETRIC SKETCH OF COUNTER-CURRENT TUNNEL DEHYDRATOR

(CODE 241)



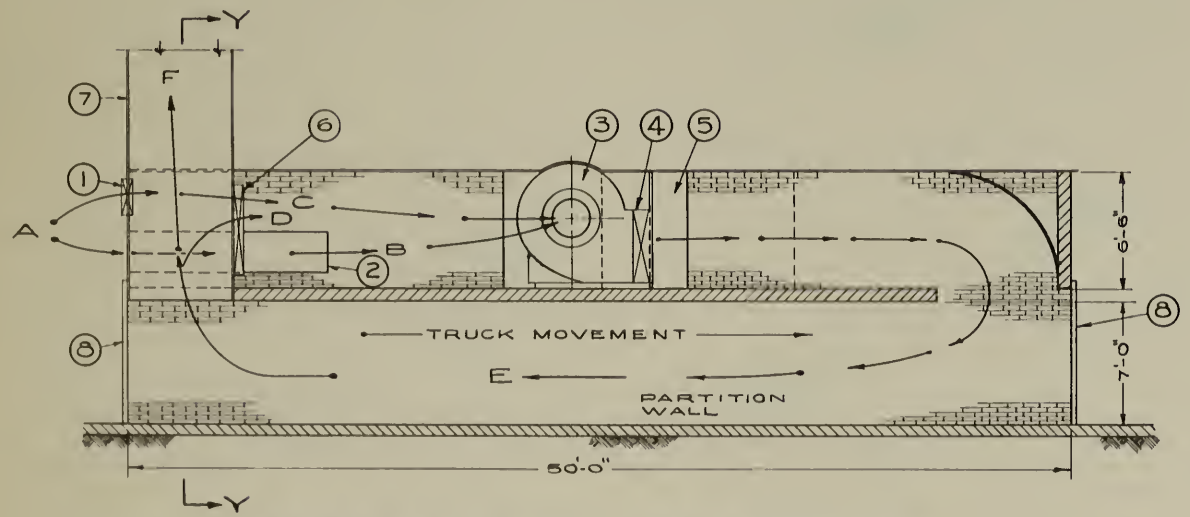
PLAN BELOW ROOF LINE

GENERAL NOTES.

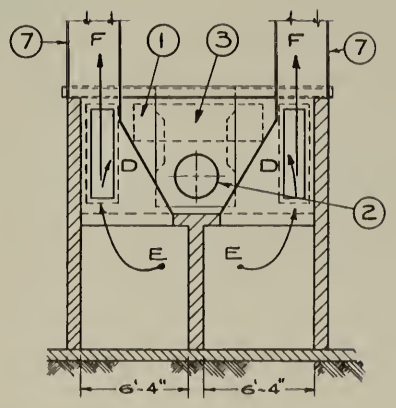
1. DAMPER TO REGULATE FLOW OF FRESH AIR
2. COMBUSTION CHAMBER – 4,000,000 BTU/HR.
3. BLOWER – ACCEPTABLE MODEL STURTEVANT SILENTVANE FAN, DESIGN 10, CLASS I, SIZE 95, DWDI, 20 H.P. MOTOR
4. SHUT-OFF DAMPERS (TWO)
5. SPLITTER DAMPER
6. DAMPERS TO REGULATE FLOW OF RECIRCULATING AIR (TWO)
7. EXHAUST STACKS (TWO)
8. ENTRANCE AND EXIT DOORS (2 SETS)

AIR FLOW NOTES

A – FRESH MAKE-UP AIR
B – HOT MAKE-UP AIR FROM COMBUSTION CHAMBER
C – FRESH MAKE-UP AIR BY-PASSING COMBUSTION CHAMBER
D – RECIRCULATED AIR FROM TUNNEL EXHAUST
E – CONTROLLED TEMPERATURE DRYING AIR
F – EXHAUST AIR FROM TUNNEL TO OUTSIDE



SIDE ELEVATION – SECTION "X X"



SECTION "Y Y"

FIGURE 6

COUNTER-CURRENT TUNNEL DEHYDRATOR FOR CRANBERRIES.

(CODE 241)

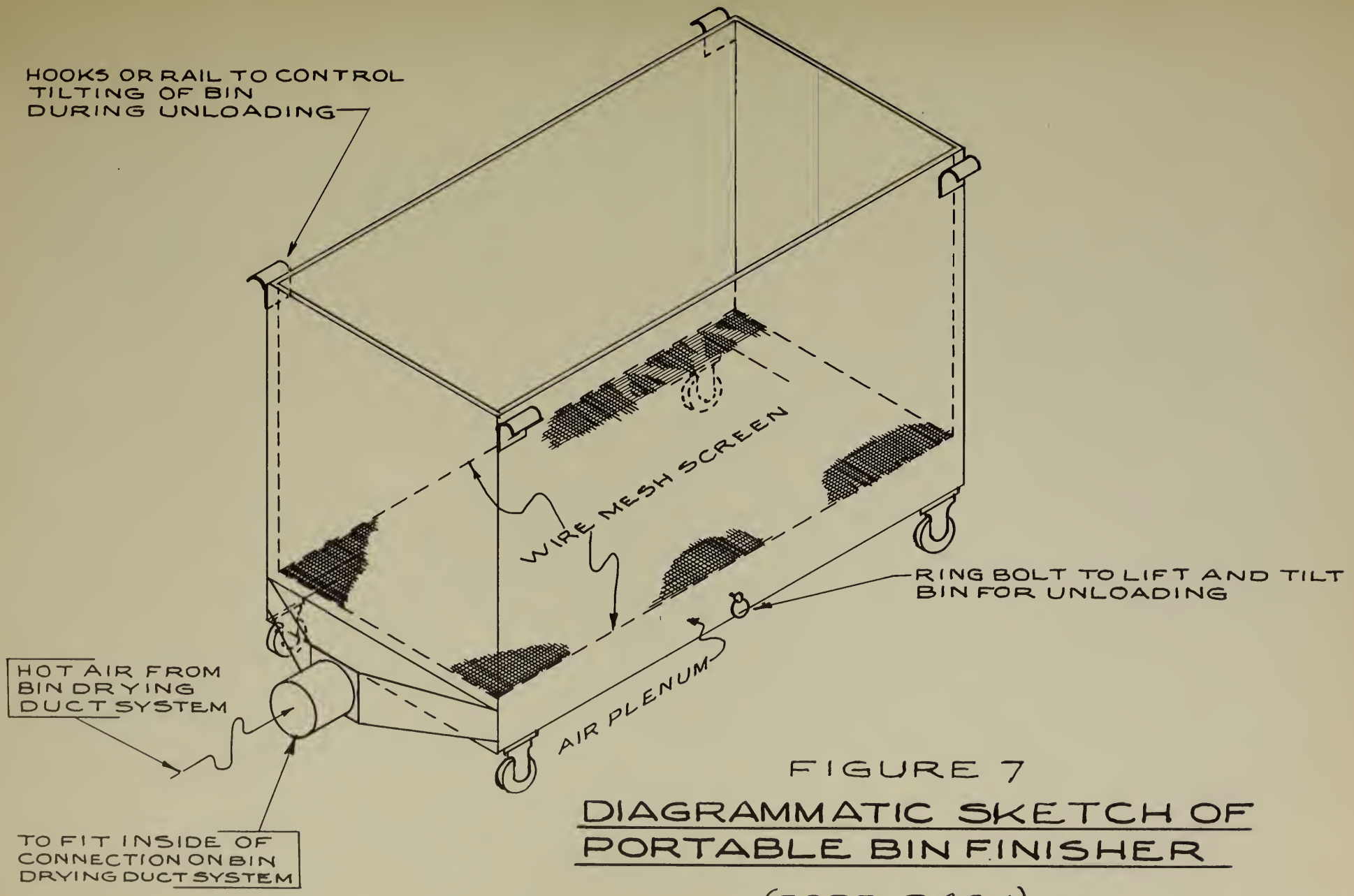


FIGURE 7

DIAGRAMMATIC SKETCH OF PORTABLE BIN FINISHER

(CODE 248.1)

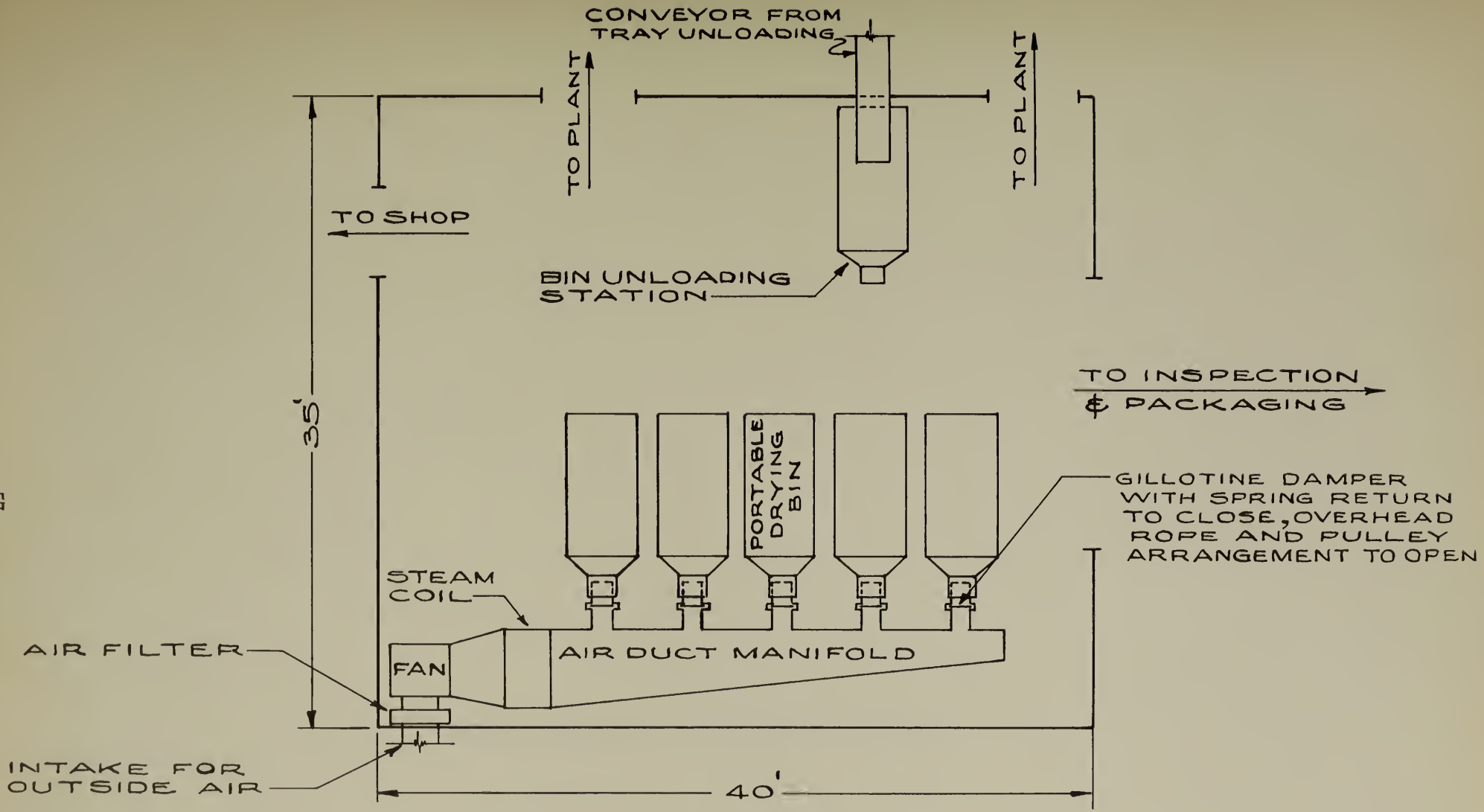


FIGURE 8

LAYOUT OF BIN FINISHING ROOM FOR CRANBERRY DEHYDRATION PLANT

(CODE 248)

GPO 88-094110